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About Authors

• **Dr. Oscar C. Bridgeman** *followed graduation from Harvard University in 1925 with the degree of Ph.D. in physical chemistry, with two years at M.I.T. as a National research fellow, working on thermodynamic problems. In 1927, Dr. Bridgeman became associated with the National Bureau of Standards as a research associate, working in the automotive power-plant section on fuel problems. In 1931 he was made chief of the Lubrication and Liquid Fuels Section. Since that time he has been engaged in both lubrication and fuel research. Dr. Bridgeman received the Manly Memorial Medal from the SAE in 1930 for his paper on airplane vapor lock.*

• **George L. Neely** *journeyed from the Pacific Coast to present his paper "High Oiliness – Low Wear" at the 1937 SAE Summer Meeting at White Sulphur Springs. He is research engineer for Standard Oil Co. of Calif., with which he has been affiliated since 1925. He has designed and put into operation a large amount of automotive testing equipment and, even before joining the Society in 1935, was active on several SAE research committees. A graduate of the United States Naval Academy at Annapolis, Mr. Neely served three years as an Ensign before joining Standard Oil.*

• **Floyd Patras** *first became connected with the bus industry in 1920, starting with the Mesaba Transportation Co., which operated out of Hibbing, Minn., and the Mesaba Transport Co., which ran buses between Duluth, Iron Range and North Shore points. In 1926 he was placed in charge of maintenance of the Northland Transportation Co.'s fleet of coaches. He took his present position as manager of maintenance, Southwestern Greyhound Lines, Inc., with headquarters at Fort Worth, Tex., in 1933.*

• **Austin M. Wolf** *has been a member of the Society since 1911. Active in its work, he has twice been chairman of the Metropolitan Section and has served as a member of the SAE Council. In addition to carrying on a general consulting practice, Mr. Wolf is automotive consultant and director of standards for New York State.*

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The Problem of Ring-Sticking in Aviation Engines[1]

By O. C. Bridgeman[2]

THE problem of ring-sticking in aviation engines is unusually complicated due to the lack of standard test methods and to the difficulties in obtaining reproducible data on full-scale engines. In fact, the immediate problem is largely one of developing suitable test equipment and methods. As soon as such a method is developed, coordination of activities by different groups becomes possible, and the problem will be well on its way toward solution.

In common with most lubrication problems, ring-sticking involves the inseparable trio of variables, namely, oil characteristics, engine-design factors, and operating conditions. During the early stages of aviation, ring-sticking was largely the result of the use of oils of inferior stability, such as vegetable oils and blends of these oils with mineral oils. Since that time there has been such a rapid improvement in oil stability and such a rapid increase in engine horsepower that engine-design factors are of much greater importance than previously. Aviation oils are now so stable at high temperatures that the older type of ring-sticking seems to have passed entirely out of the picture.

As far as oil characteristics are concerned, the ring-sticking of today in high-output aviation engines is tied up with so-called "oiliness" as well as stability. Although ring-sticking in many of these engines probably can be minimized by alterations in design, present indications point to the necessity for using compounded oils of high oiliness and stability if satisfactory ring performance is to be obtained in engines of higher horsepower per cubic inch displacement than those in use at present.

INCREASES in the horsepower output of aviation engines per cubic inch of displacement are predicated upon the availability of a suitable lubricating oil. Development of improved refining processes to increase the stability of aviation oils is predicated upon the ability of the oils to give more satisfactory performance in aviation engines. Each new advance in either the aviation-engine or the aviation-oil industry involves the other and frequently introduces unsuspected difficulties. Each month sees new problems, better cooperation between the two industries, and the necessity for revision of old viewpoints and adoption of new ones. The ring-sticking problem always has been a matter of concern, but year after year has passed without its becoming of major importance. Now it begins to appear that certain limitations have been encountered, and that new concepts must be evolved in order to extend the horizon. Among other things, a more detailed knowledge of the ring-sticking problem is necessary as a guide in indicating the future course in engine design and in oil development.

[This paper was presented at the Annual Meeting of the Society, Detroit, Mich., Jan. 13, 1937.]

[1] Publication approved by the Director of the National Bureau of Standards of the U. S. Department of Commerce.

[2] Chief, Lubrication and Liquid Fuels Section, National Bureau of Standards, Washington, D. C.

An analysis of the ring-sticking problem requires consideration of first principles. The object of an internal-combustion engine is to transform energy released by the fuel on combustion into mechanical energy. This transformation is effected through the medium of a piston reciprocating in a cylinder closed at one end and, in order to be efficient, leakage of gas from the cylinder through the annular space between the piston and cylinder should be minimized. Following the practice adopted many years ago in steam engines, this purpose is accomplished by using piston-rings fitting into grooves cut in the piston. During operation, the rings must move back and forth in the ring-grooves and, in order to reduce friction in the ring-grooves and between the rings and the cylinder walls, lubricating oil is employed. The oil also assists in sealing against gas leakage. Thus, during the course of operating an engine, the rings are continually in contact with lubricating oil at elevated temperatures and at times they may be in contact with unburnt fuel residues. One of the outstanding characteristics of present-day fuel residues and of lubricating oils is that they tend to thicken and become very viscous when exposed to high temperatures, the rate of thickening depending upon the temperature and the properties of the oil or fuel residue. If the thickening process goes sufficiently far, motion of the ring in the ring-groove is restricted

and ring-sticking ensues. The cause of ring-sticking is, therefore, the retention of any given portion of oil (or fuel residue) in the ring-grooves long enough to permit thickening to the point where ring motion is restricted. The cure for ring-sticking is to keep the oil (or fuel residue) moving sufficiently fast through the ring-grooves so that thickening to a critical extent is avoided. The rate at which the oil should be circulated depends upon the temperature, the characteristics of the oil, and various design features of rings and ring-grooves.

Ring-sticking resulting from accumulation of fuel residues in the ring-grooves is so comparatively rare in aviation engines that this phase of the subject can be dismissed with a few words. It is ordinarily caused by the use of a fuel containing unstable compounds, such as may be used to raise the octane number and which will polymerize readily under heat and become gummy. This type of ring-sticking usually is accompanied by extensive gum deposits in the intake manifold and by sticking inlet valves. Suitable selection of fuel is all that is required to avoid its occurrence.

Ring-sticking caused by oil is by far the most common form and the one which presents the most serious problems in its elimination. Some of the more important variables affecting ring-sticking will be considered in turn.

Effect of Temperature

As mentioned previously, all oils now used will thicken if maintained at elevated temperatures, the rate at which this thickening occurs depending upon the temperature and upon the characteristics of the oil. The effect of temperature may be very marked and when near the "critical" value, a change of a comparatively few degrees may cause serious ring-sticking. Thickening appears to be a combination of two effects: first the evaporation of the more volatile, less viscous fractions, and second the cracking and polymerization of the remainder. With vegetable oils, such as castor oil, thickening and ring-sticking occur at comparatively low operating temperatures. With oils of moderate stability, the situation appears to be somewhat complicated, and there is evidence suggesting that there may be a critical temperature range, above and below which there is freedom from ring-sticking. This condition seems reasonable for, as the temperature is raised, the rate of evaporation of the oil may reach such a high value that the oil will not remain in the ring-grooves sufficiently long to thicken to a critical extent. Under these conditions, ring and barrel wear may even be reduced until the temperature becomes so high that inadequate lubrication results.

Many of the new aviation oils are highly stable, solvent-refined products which can be maintained at relatively high temperatures for comparatively long periods without much increase in viscosity. There are indications, however, that the solvent-refining process may be carried to such extremes that the oil will not maintain a lubricating film on the hot cylinder walls, but will break up into drops. Under these conditions, the liquid seal around the upper piston-ring is lost and hot gases from the combustion-chamber may penetrate between the upper ring and the cylinder wall. If this situation persists, the oil in the upper ring-groove may become so thick that the ring will stick, thus permitting freer access of the hot exhaust gases to the second ring. Continuation of this process leads to successive sticking of the various rings, to severe ring and cylinder-barrel wear and, possibly, to piston seizure as a final result. It has been suggested that there may be a critical temperature range even in this case of ring-sticking with oils in which the solvent-refining process has been carried to extremes, but the author has seen no evidence to verify this suggestion.

Control of temperature, keeping it below the critical value for the type of aviation oil available, is perhaps the most certain method of ensuring freedom from ring-sticking. As the horsepower output of an engine per cubic inch of displacement is increased, every effort should be made to increase the rate at which heat is removed from the piston and, thereby, to maintain piston temperatures as low as possible. Obviously there is a limit to the effectiveness of this method when considering conventional piston design, and other methods must be resorted to, such as the improvement of that phase of oil stability which controls ring-sticking and the modification of ring and ring-groove design so as to keep the oil circulating faster in the ring-grooves.

Effect of Oil Characteristics

As pointed out in the previous section, oils differ widely as regards their tendency to cause ring-sticking. Under some conditions, vegetable oils will cause the rings to stick in a few hours of operation. The tendency of mineral oils to cause ring-sticking depends largely upon the degree of refining, freedom from difficulties becoming more certain as the stability is increased until possibly a point is reached beyond which the oil becomes deficient in lubricating ability and ring-sticking results as a consequence of increased blow-by. One of the most serious handicaps to the development of suitable oils is the lack of a significant method for determining oil stability under conditions analogous to those in the engine when ring-sticking occurs. Most of the methods employed for determination of oil stability have been developed for automobile engine lubricating oils and about 350 deg. fahr. appears to be a favorite temperature of test. In the engine, temperatures around the upper ring are probably more nearly of the order of 600 deg. fahr. or higher, and there is reason to believe that the results of stability tests at 350 deg. fahr. are not generally applicable to these higher temperature conditions. Possibly the research method used by the Wright Aeronautical Corp. could be employed as the basis for the development of a standardized stability method. In any event, it seems evident that the development of improved oils as regards ring-sticking is being handicapped seriously by the lack of appropriate test methods.

Recently there have been frequent statements to the effect that the stability of oils has been improved to such an extent that further increases in stability can be obtained only at the expense of a sacrifice in lubricating ability. Regardless of whether or not this point has yet been reached, it does not seem unreasonable to suppose that such a limit exists. Under such conditions, further improvements in conventional oils are only possible by the use of compounding agents. It is understood that certain types of compounds are effective in reducing ring-sticking in Diesel engines, and the use of these or other types of compounding agents opens up a wide field of investigation. Availability of suitable test methods is a prerequisite to any rapid accumulation of knowledge along these lines.

Of more theoretical interest at present, but still within the realm of practicability, is the possible development of lubricating oils which will become less rather than more viscous when maintained at elevated temperatures. It is known that lubricating oils can be produced under appropriate conditions by polymerization of hydrocarbons of low molecular weight, and it is known also that the polymerization process may be reversed at sufficiently high temperatures with resulting rapid decrease in viscosity. It is not known to what extent such oils would give freedom from ring-sticking, but at least the possibility exists for the synthetic development of oils of controlled characteristics for the lubrication of the high-output engines of the near future.

There is one property of aviation oils which appears to have

been given little consideration from the standpoint of ring-sticking but which appears to the author to have definite importance, namely, oil viscosity. It is the fundamental principle of lubrication that the lightest possible oil be used in any given application. Rarely are heavy oils required for lubrication, but rather they are employed ordinarily to conserve oil and to compensate for deficiencies in design. The number of mechanical parts requiring replacement due to use of too light an oil is negligibly small as compared to the replacements necessitated by use of too heavy an oil. In an engine the use of a heavy oil results in high friction, rapid rate of wear, extensive carbon formation, and in ring-sticking. The recent improved lubrication of automobile engines is indicative of what may be accomplished by a lowering in oil viscosity. Oils used in aviation engines appear to be at least one grade and possibly two grades too heavy. It is difficult to predict just how much improvement in aviation-engine lubrication would be possible by a lowering in oil viscosity, with accompanying decreases in clearances and reductions in oil consumption, but investigations of the effect of oil viscosity on engine wear and on ring-sticking certainly should result in the acquisition of valuable data and might go far towards solving some of the existing lubrication problems of aviation engines.

Effect of Ring Design

When the position is reached in the development of high-output aviation engines where it is not possible to effect any further lowering of piston temperatures and where it is not possible to operate these engines on available oils without extensive trouble from ring-sticking, the only recourse is to modify ring and ring-groove design so as to maintain the rate of oil circulation in the ring grooves sufficiently high to prevent the oil from thickening to the extent of causing ring-sticking. No attempt will be made to suggest possible modifications in design, but unquestionably marked improvements are possible and are needed even today. Increases or decreases in the side clearances between the rings and the ring-grooves are the simplest modifications, but they are trivial compared to the modifications in design which are possible.

Every operator of an aviation engine can remember finding at some time or other a ring stuck for no apparent reason. Although it was unquestionably true that the oil was responsible for the actual occurrence, the real reason was probably a faulty ring. The function of the compression rings, at least, is to form a seal between the combustion-chamber and the crankcase, assisted by a thin film of oil. Obviously, the seal will be inadequate if the ring touches the cylinder walls only at a few high points around the circumference. This statement may appear to be an exaggeration, but rings are made and used which are so far from being circular that extensive wear is necessary before a proper seating against the cylinder wall can be established. Under these conditions, the blowby past the ring may be so excessive that it will stick in a comparatively short time with an oil which would otherwise give satisfactory performance. Fortunately a few manufacturers of piston-rings are now experimenting with special gages for detecting imperfect rings of this type. Specifications on circularity and on distribution of tension around the ring should be adopted as a first step towards reduction in ring-sticking and excessive wear difficulties.

Formation of an adequate seal between the piston-ring and the cylinder wall throughout the entire stroke also implies ease of motion of the ring in the ring-groove. This ease of motion is only possible if the surface of the ring is smooth and if the ring is flat. Both of these considerations are important from the standpoint of ring-sticking and should be the subject of special attention on the part of the ring manufacturers.

Although it is recognized that progress is being made continuously in ring design and standardization of tolerances, it is felt that too much emphasis cannot be placed on further perfection of piston-rings and that such effort will be well repaid in reductions in ring-sticking troubles and in decrease in ring and cylinder-wall wear.

Conclusion

In conclusion, it should be emphasized that ring-sticking involves all three factors of oil characteristics, operating conditions, and design features. From the standpoint of the petroleum industry, lack of adequate laboratory test methods for ring-sticking is the main hindrance to rapid development of improved oil. Considerable impetus would be given to the establishment of adequate test methods if the manufacturers of aircraft engines had better information regarding piston temperatures, and acquisition of this information should be feasible with new methods now under development. Research on design of piston-rings and ring-grooves and on standardization of ring characteristics offers one of the most fruitful fields for the improvement of aircraft-engine lubrication, and is urgently needed. Finally, the ring-sticking problem can be maintained under control only by the continuous improvement in oil characteristics, by the constant attempt to remove increasingly greater amounts of heat from the pistons, and by the fullest cooperation on the part of the ring manufacturers in striving to produce that most difficult of products, the perfect piston-ring.

Effect of Addition Agents on Piston and Ring Performance

THE recent trend toward high-output gasoline and Diesel engines has revealed a pronounced increase in the number of stuck rings and piston-ring or cylinder-liner wear. Crankcase oil stability, as measured in the chemical laboratory by comparing the complete analysis of the new oil and the used oil taken from the engine at the end of the test, was formerly of importance in the appraisal of oil performance. However, recent S.A.E. and other papers brought forth that classification of lubricants should be made in terms of engine performance and maintenance cost. Ring-sticking is the problem, as is piston-ring or cylinder-liner wear. Research into this problem is divided into that for high-output gasoline engines and that for the Caterpillar Diesel. The overall operating temperature of the engine in question does not alone constitute the problem of ring-sticking. High local temperatures, time, and volume of output are the real factors which form a major part of the problem. Avoiding wear by providing lubricants which will not break down at operating temperatures and will continue to lubricate at the pressures encountered, is necessary.

The wear and ring-sticking tendencies work carried on in 1935 and 1936 proved that, only after very long extended periods of operation, did the passenger-car engine show small amounts of wear or any form of ring-sticking and that addition agents were not yet needed. However, the most pronounced problem was in high-output engines, especially in the supercharged aircraft engine. Since the aircraft engine gave the best picture in the shortest time for gasoline-engine wear and ring-sticking tendencies, full scale 50-hr. tests were made.

Excerpt from the paper: "Effect of Addition Agents in Lubricating Oil on Piston and Ring Performance in Gasoline and Diesel Engines," by C. M. Larson, supervising engineer, Sinclair Refining Co., New York, presented at the National Tractor Meeting of the Society, Peoria, Ill., April 21, 1937.

High Oiliness – Low Wear?

By G. L. Neely
Standard Oil Co. of Calif.

IN our investigation of addition agents for lubricating oils, one of the most striking observations has been that the great majority of oil-soluble compounds will reduce the coefficient of friction for some operating condition. It is, therefore, a simple matter to find an addition which merely improves oiliness. The effectiveness of such compounds on the wear-reducing value of the lubricants often may be considerably different in degree, and sometimes in direction, from the effect on friction. It is the purpose of this paper to present some interesting data along these lines with the hope that these experiments may, in some measure, contribute to a better understanding of some of the theories of oiliness, wear, and other properties of lubricants in the thin-film zone.

The present-day interest in the subject of wear relates primarily to the cylinder walls and piston-rings of internal-combustion engines and their lubrication. During the last year there have been many reports and papers presented pertaining to engine wear and the influence of the type of lubricant used. The majority of the lubricants used in the engine wear tests reported were selected from friction or film-strength tests, but not from wear tests. A review of the literature shows a paucity of data illustrating fundamental relationships among friction, wear, and operating variables. This paper does not pertain to engine wear directly, but presents some data on friction-reducing and wear-reducing value as obtained in a special laboratory machine designed for that purpose.

[This paper was presented at the Semi-Annual Meeting of the Society, White Sulphur Springs, West Va., May 6, 1937.]

[1] U. S. Patent No. 2,020,565.

Description of Testing Machine

The machine used is called the Kinetic Oiliness Testing Machine – Model B.[1] It is similar to the one (Model A) described in our paper "Friction Testing Methods" presented before the A.P.I., June, 1932. The Model B machine is shown photographically in Figs. 1 and 2 and in cross-section in Fig. 3. The frictional elements are shown separately in Fig. 4 and consist of two opposing surfaces, one in the form of a track having two flat-topped, sharp-edged, concentric rails and the other consisting of three buttons, each having at its outer edge a sharp-edged, flat rim.

This machine was designed to minimize the effects of viscosity in order to investigate lubricants under conditions where oiliness effects predominate. Another important feature of the machine is that the surfaces are maintained automatically at a fairly uniform degree of smoothness by the lapping action produced by the combined rotating and sliding motion of the buttons.

Referring to Fig. 3, the buttons, 1, are positioned by and loaded through the spindle shafts, 2, secured in the spindle-

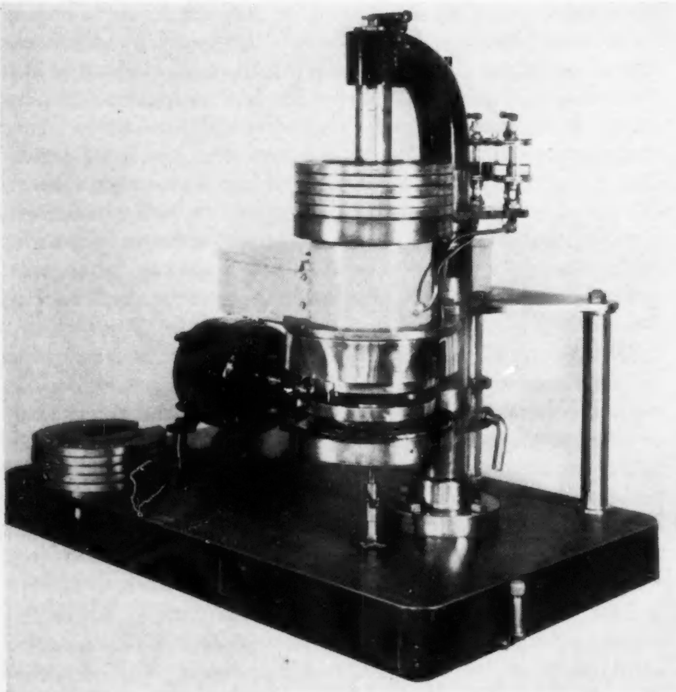


Fig. 1 – Kinetic Oiliness Testing Machine – Model B – General Assembly

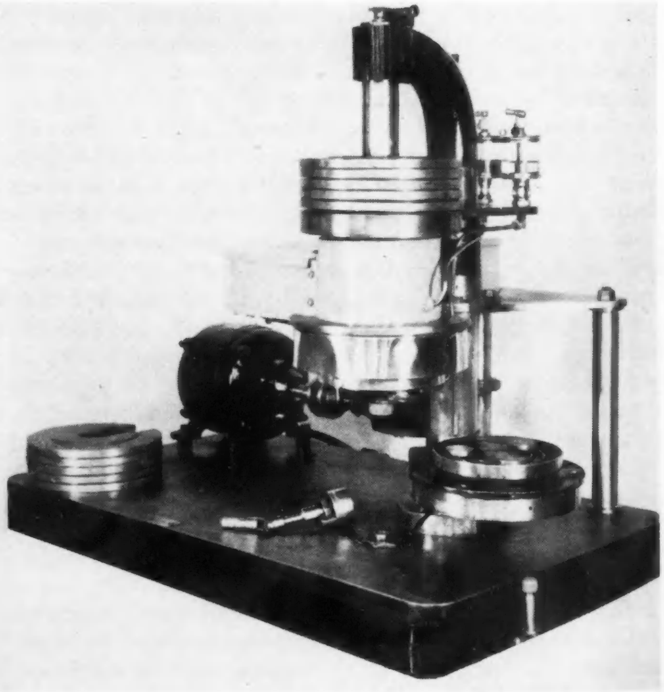


Fig. 2 – Kinetic Oiliness Testing Machine – Model B – Partially Disassembled

THE purpose of this paper is to call attention to the need for fundamental wear investigations and to show that wear does not correlate with oiliness.

A testing machine suitable for measuring both friction and wear is described. The machine, which is a modification of one previously reported by the author, uses two sets of frictional surfaces – one in the form of a track having two concentric rails and the other consisting of three small buttons with recessed centers and flat tracks on the outer edges. An important feature of the machine is that the rubbing surfaces are maintained automatically at an almost uniform degree of surface smoothness by the lapping action produced by the combined rotating and sliding motion of the buttons.

The results presented lead to the following conclusions within the thin-film range investigated:

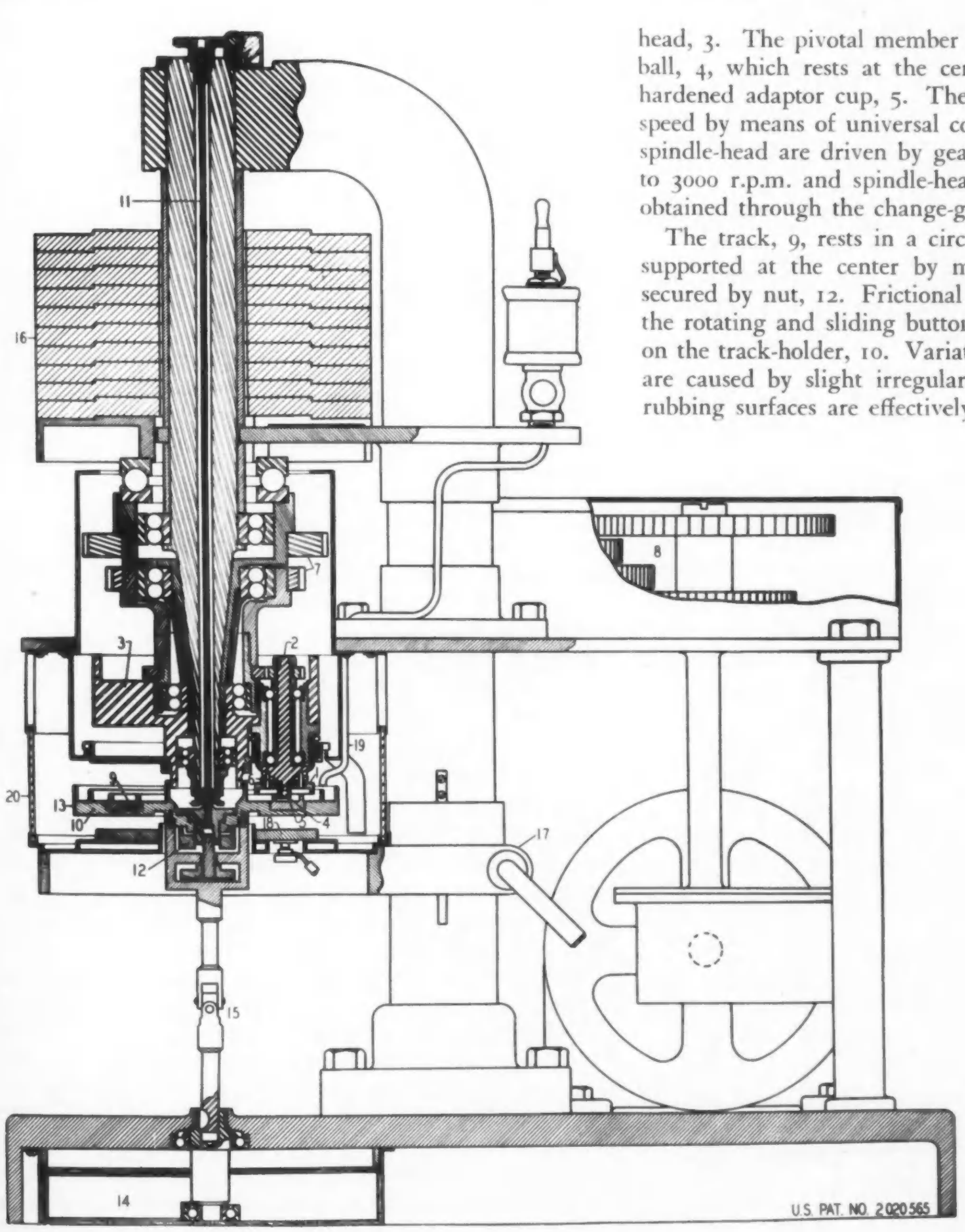
(1) Both wear and friction vary directly with load.

(2) Total wear reaches a maximum, in some cases, at one particular speed, whereas wear rate (metal removed per unit of linear surface rubbed) decreases generally as speed is increased.

(3) No direct relation exists between wear and friction.

A new term, "coefficient of wear," relating wear rate and load is proposed.

No attempt is made to correlate the data obtained with other types of operation or metal combinations as data on these problems are incomplete at the present time.



head, 3. The pivotal member of each spindle shaft is a steel ball, 4, which rests at the center of the buttons, 1, in the hardened adaptor cup, 5. The buttons are driven at spindle speed by means of universal connectors, 6. The spindles and spindle-head are driven by gearing, 7, and spindle speeds up to 3000 r.p.m. and spindle-head speeds up to 200 r.p.m. are obtained through the change-gearing, 8.

The track, 9, rests in a circular track-holder, 10, which is supported at the center by means of the torsion wire, 11, secured by nut, 12. Frictional torque on the track caused by the rotating and sliding buttons is indicated by the scale, 13, on the track-holder, 10. Variations in frictional torque which are caused by slight irregularities in the smoothness of the rubbing surfaces are effectively damped out by means of the

Fig. 3 – Kinetic Oiliness Testing Machine – Model B – Cross-Section

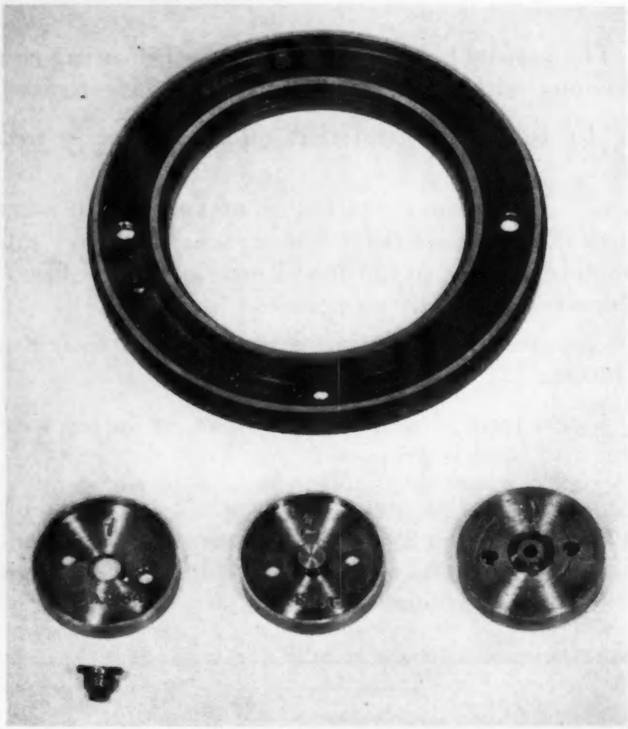


Fig. 4 – Kinetic Oiliness Testing Machine – Model B – Frictional Surfaces Used as Test Specimens

dash pot, 14, attached to the track-holder, 10, through the flexible connection, 15. The desired degree of loading is obtained through the weights, 16, acting downward on the buttons through the spindle-head assembly.

Upon disassembly, the dash pot, 14, is disconnected; the nut, 12, is removed releasing track-holder, 10; and the arm, 17, which supports the electric heater, 18, is lowered and swung to one side as shown in Fig. 2.

Test oil is supplied to the track through tubing, 19. The test elements of the machine are enclosed by means of the cylindrical glass, 20, in order that tests may be made with various surrounding atmospheres.

Test Procedure

The testing procedure was very simple: The machine merely was assembled and operated with the test lubricant for a given set of conditions, load, speed, and duration. Measurements of friction were obtained during the run, and wear was determined by weighing the buttons before and after each test. While testing, a small amount of make-up lubricant was fed from the sight-feed oiler. Friction and wear values were obtained at a number of loads and speeds using an oil temperature of 175 deg. fahr. The maximum dead load was 41 lb., which corresponds to a unit loading of approximately 750 lb. per sq. in.

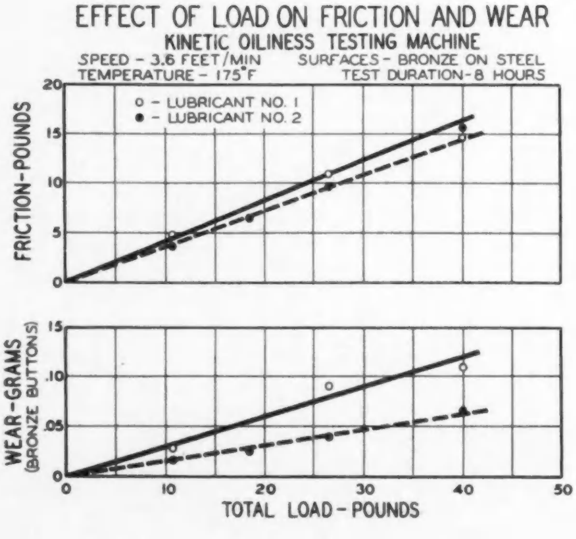


Fig. 5

The metal combination used was a ground, hardened steel track and S.A.E. No. 64 phosphor-bronze buttons. The steel track showed no measurable wear in these tests, whereas the wear or amount of metal removed from the buttons was of sufficient magnitude to be measured easily and was found to be proportional to the operating time.

Test Results

Effect of Load. – Typical test data are plotted in Fig. 5 in which variations in the frictional resistance and wear with load are shown for two lubricants. It will be noted that both the frictional resistance and the wear vary directly with load. The fact that friction varies directly with load or, in other words, that the frictional coefficient is not affected by load (at least at moderate loads) is of interest since it complies with Amonton's law of solid bodies which states that the coefficient of friction is not influenced by the intensity of loading.

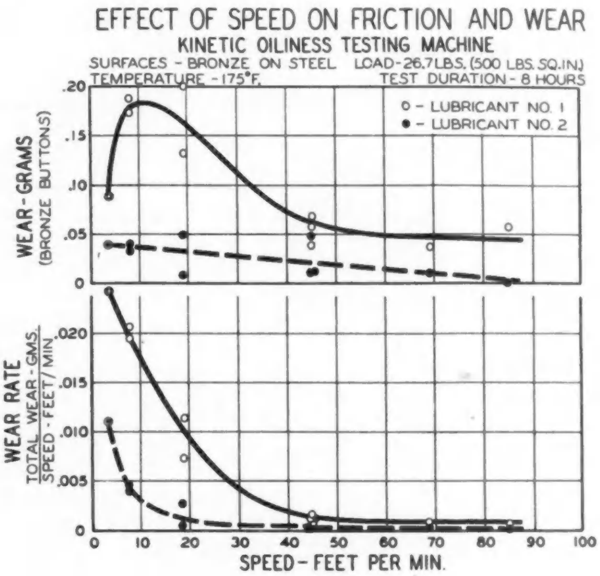


Fig. 6

Effect of Speed. – Fig. 6 shows the effect of rubbing speed on wear. The speed used was the resultant of the rotating and sliding speed of the buttons.

The plot of the total wear is of especial interest since it shows that with Lubricant No. 1 there is one particular speed at which the greatest amount of wear takes place in a given period of operating time. On the other hand, with Lubricant No. 2, it would seem that the maximum amount of wear occurred near the minimum speed shown. It is also shown that the wear rate, which equals the total wear divided by the rubbing speed (distance) decreases as the speed is increased. Thus it is seen that the point of maximum wear per unit of time may occur where the speed equals a certain value, whereas the amount of metal removed per unit of distance traveled is greatest at the lowest speed. This finding is obviously of interest with respect to reciprocating mechanisms.

Fig. 7 shows the effect of speed on the coefficient of friction and on a wear factor which involves the total wear divided

by the load and the total resultant distance traveled (by the buttons). This factor is described as "coefficient of wear" and appears to be fundamental for the data obtained thus far on this machine for the steel-on-bronze metal combination used. As may be noted, the factor is of extremely small magnitude. Dividing wear by load produces a coefficient similar to coefficient of friction. Wear, however, takes place continuously and is a function of time. Therefore, in order to allow a cross-comparison of wear values obtained at different loads and in tests of different duration, the "coefficient of wear" must also include a time factor which has been included as distance for convenience.

Inasmuch as considerable time is required to conduct each wear test, we have not yet completed investigation of the relation of wear to load for the entire speed range of the machine.

Effect of Addition Agents

The effects of different types of small quantities of addition agents on friction and wear are shown on Fig. 8. The addition of compounds *A* and *B* was, in effect, the same as re-

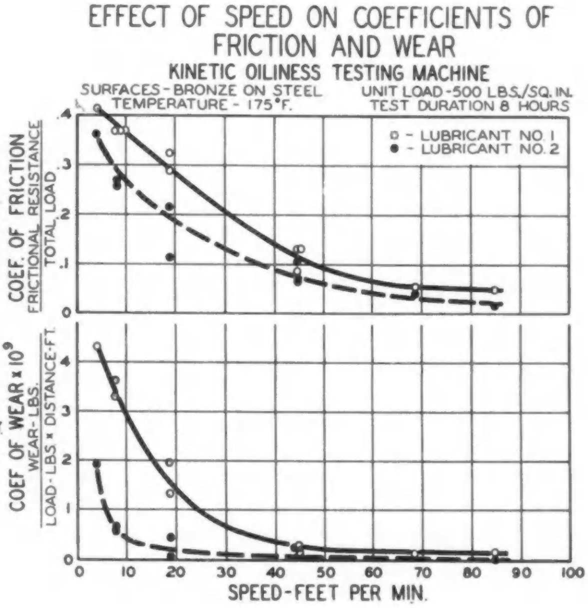


Fig. 7

ducing the load as is shown by the fact that the points for the oils containing these compounds, 1-*A* and 1-*B*, fall on the line joining the points obtained at various loads with Lubricant No. 1. Thus the friction-reducing value was indicative of wear-reducing value with these two compounds. However, Compound *D* had entirely different characteristics in that the wear with Lubricant 1-*D* was reduced to a far greater degree than was the friction. Compound *C* had an intermediary effect.

On the other hand, the addition of Compound *E* to Lubricants 1 and 2, while slightly reducing the friction, greatly increased the wear. This result is shown by comparing points 1-*E* with 1, and 2-*E* with 2.

Lubricants Nos. 5 and 6 are of interest in that they show that it is possible to obtain extremely small amounts of wear and yet possess relatively poor friction-reducing properties. These data illustrate the futility of attempting to predict wear-reducing value from friction tests.

Fig. 9 presents the same data shown in Fig. 8, but the scheme of plotting coefficient of friction versus our "coefficient of wear" is utilized. It will be noted that, although perfect correlation between these two coefficients was not

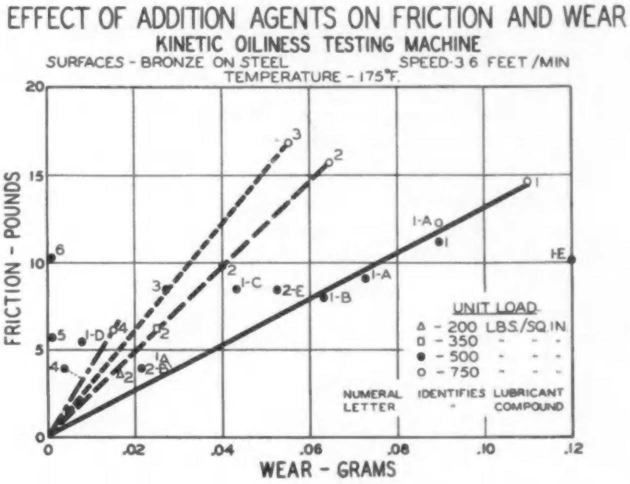


Fig. 8

obtained, the points for the same lubricants at different degrees of loading are fairly well grouped.

Discussion

One of the important observations in our tests was the effect of the surface condition of the hardened steel track. When the surface was prepared to a smoothly ground finish, data of the type shown on the charts were obtained whereas, with a mirror-finished track surface, the friction was somewhat reduced though wear was reduced to a much greater degree. Furthermore, with a mirror-surfaced track, the influence of addition compounds was much less pronounced. This effect of surface smoothness for the steel-on-bronze metal combination applies only to the steel surface as the bronze buttons attained a mirror-like smoothness in a very short operating time whereas the steel track did not wear perceptibly even over long periods of time.

Our paper of 1932 mentioned previously related principally to oiliness effects on cast-iron surfaces. It is significant that, with this metal combination, the wear obtained with lubricated surfaces was too small to be measured, even for extended periods of operating time. The present Kinetic Oiliness Testing Machines do not provide high enough load ranges to make them suitable for wear testing for the cast-iron metal combination, and a third design is now being arranged where loads of much greater magnitude can be employed.

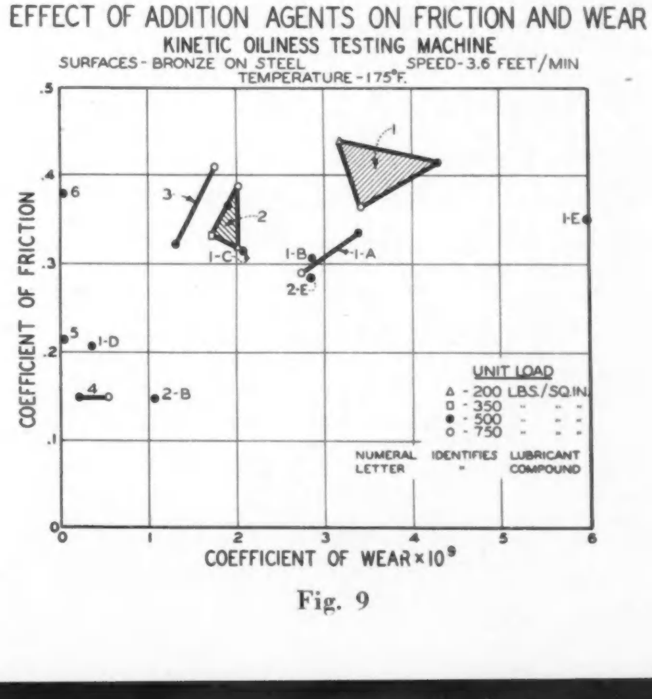


Fig. 9

Insufficient data have been obtained to evaluate adequately the effects of such factors as temperature and viscosity. The time required for each test precludes the possibility of rapid progress in this field of lubrication study. It is, therefore, hoped that this paper will stimulate research work relating to wear testing in order that the combined efforts of a large number of investigators may serve to accelerate the growth of fundamental knowledge on this subject.

In conclusion, it is believed that the data presented definitely show that friction and wear do not correlate and that high oiliness does not necessarily result in low wear.

Discussion

Stresses Importance of Excluding Dirt

– F. L. Garton
Shell Petroleum Corp.

THERE has been so much confusion due to the use of the term, oiliness, to cover a variety of phenomena that the data presented by Mr. Neely must be regarded as very timely. Some experiments made in our own laboratory, using the Four-Ball machine developed by the Royal Dutch laboratories in Holland, have shown that under high-load conditions, oils of the same viscosity and viscosity index may show closely similar friction characteristics but measurable differences in wear, which confirms Mr. Neely's experiments, although we have not been able to trace the simple relationship that he has shown.

As Mr. Neely remarked, work of this kind is laborious and time-consuming, and it probably will be some time before all the factors have been studied. In considering the practical application of the data so far obtained, it must be borne in mind that, in practice, abrasive dirt and a greater or lesser amount of sludge are usually present, and their presence may tend to mask the effects due to the oil. In our own experiments we have found that, unless dust is carefully excluded, it is impossible to obtain consistent results.

The wear curve shown in Fig. 6 of Mr. Neely's paper for lubricant No. 1 is interesting. Is the same general shape of curve obtained at loads other than that shown?

Contends Oiliness Contributes to Wear Reduction

– A. E. Burwell
Alox Corp.

MR. NEELY has set out one of the real needs of oil testing, especially in the realm of so-called oiliness. Further, he has recognized a fundamental and has done something about it. It is for this reason that I consider Mr. Neely's contribution highly important and stimulating to further work which should tend, if properly conducted, further to contribute to a better knowledge of oiliness.

As a matter of fact, in operating machines of all imaginable sorts, our company has gathered a rather large amount of evidence showing, we believe, very definitely that a proper degree of oiliness in lubricating oils of the most various kinds, contributes infallibly to the reduction of wear.

One of the outstanding criticisms I would offer to Mr. Neely for his consideration would be to increase the unit pressures in his machine, if possible, to the breaking point of the films formed. I believe that such a procedure would show much more definitely the effect of proper oiliness in less time. In this connection he might also study the effect at high drags of various oiliness compounds on various bearing metals. This would not necessarily entail the changing of the tracks but would only entail the changing of the button faces.

Another criticism which I wish to bring out, and which I hope will be constructive, is the necessity for having the tracks highly polished and as even as possible throughout their length and width. They also should be made of sufficiently hard material that, even under rather high pressures, they will not be subject to distortion.

Another suggestion would be for one using this machine to watch the surfaces of the tracks by frequent microscopic examination for evidence of corrosion so that probably more uniform results can be had and so that wear of the impressed bearing metals may be attributed to the proper cause. Incidentally, I believe that Mr. Neely has recognized this need but he has not formulated it as definitely as could be wished.

As stated elsewhere, the Alox Corp. staff believes that it is possible to select addition compounds that will lower friction, greatly decrease wear and, in many cases, prevent corrosion due to chemical changes in the lubricant. It is our present hypothesis that, because addition products have a distinctly higher affinity for metal surfaces, they form, together with certain similar compounds already contained in the oils to which they may be added, selectively segregated films on the metal and definitely exclude, in many cases, harmful products of chemical change in the oil.

I particularly like Mr. Neely's "coefficient of wear." His description is clear and I believe has considerable value. In this connection, it probably should be brought out that there are many additives which will cause higher friction; and, in many cases with soft bearing metals, greater wear. Such additives should be excluded from the crankcase and used only in places, such as steel-on-steel, where the films formed are not so stiff as to cause wear and yet to a great extent will prevent metal-to-metal contact (E.P. lubricants). It is to be seen readily, however, that the machine proposed by Mr. Neely will quickly evaluate and distinguish between the various film-forming materials, those causing low friction being suitable for crankcases and frequently those causing high friction being suitable as E.P. materials not, of course, because of their high friction.

Again, to state more carefully our conception of Mr. Neely's contribution, we believe his investigation of lubricants at very *low speeds* to be a very distinct addition to our knowledge of the proper functioning of lubricants.

In conclusion, we believe the last paragraph of Mr. Neely's paper to be correct in all respects. We are also glad that study along these lines is going forward and hope that further work will be done by more people having penetrating minds and the ability to work out methods of ascertaining the truth still hidden in "lubrication."

Value of Actual Engine Tests Stressed

– M. Fairlie
Sinclair Refining Co.

I SHOULD like to ask Mr. Neely how closely wear results can be duplicated on his machine.

In previous papers and discussions, Mr. Neely has stressed the importance of the use of an atmosphere to surround bearing test machine parts representative of that existing in engine crankcases. I should like to ask if such an atmosphere was used in making these tests.

I do not know whether Mr. Neely feels at liberty to disclose the nature of any of the characteristics of the agents he used, but it would be of interest to hear if he relates the rapid wear found in the case of certain compounds in relation to frictional value, such as his compound *E*, to possible chemical activity on the part of the agent.

As a result of efforts to correlate laboratory wear and friction data on compounded oils with actual service results, we have come to the conclusion that there is nothing to equal an actual engine test to determine the true value of such compounds. We have had several instances lately of useful compounds that would have been ignored entirely on the basis of purely laboratory tests, had not actual engine tests been made. We have received a similar impression from statements Mr. Neely has made in the past and are curious to know if results he has obtained on this test machine have changed his opinion to any extent.

Similar Results Announced

– E. R. Barnard
Standard Oil Co. (Ind.)

IT is very gratifying to find that there are those who recognize the need for complete information on the behavior of addition agents, particularly in view of the now widespread and still rapidly increasing use of these materials. It is inconceivable that all the possible and perhaps even important effects of any of these agents are known, although in the press of competition there is a rush to place such products before the public. If it does no more than to plant the seeds of discrimination and caution in some over-zealous breast, Mr. Neely's paper will have attained a worthy object.

Unfortunately, we are not in a position at this time to add a great deal of information on the effect of oily materials on wear; but, thus far, we too have noted that a reduction of friction between heavily loaded rubbing surfaces is frequently attended by increased wear. In fact this occurrence appears to be the rule rather than the exception.

At Whiting, Ind., the work has been directed principally toward accuracy and reproducibility in friction measurements with what we believe to be a fair degree of success. Rubbing speeds employed in this work cover almost identically the range used by Mr. Neely; but our unit loads are much higher. It may be of interest to note that we also have substantiated Amonton's law and that it holds absolutely for all unit loads below the elastic limit of the rubbing materials. When the elastic limit of one of the metals is exceeded, the coefficient of friction rapidly increases with load. Yield points thus determined have been checked against actual tensile tests and found to agree exactly. At high unit loads, however, we have not been able to obtain reliable friction measurements from freshly ground or machined surfaces. We believe that the final generation of the surfaces must be accomplished by rubbing them together under high pressure if check determinations on reference points are not to show a decided drift. Apparently Mr. Neely's wear measurements also must depend largely upon the ability of a grinding machine to reproduce accurately track surfaces. We should like to know whether or not a freshly ground track is used for each test.

Although we are not sure that tests as conducted by Mr. Neely can be interpreted directly in terms of cylinder, piston-ring, bearing, and gear wear, we do believe that he has taken a step in the right direction. In a day of high specific engine outputs and heavy gear and bearing loads, an apparent lack of fundamental knowledge of "oiliness" and wear does not reflect a great deal of credit upon this Society or the industries that it represents. We, at Standard Oil Co. (Ind.), feel that the time for doing something about it is over-ripe, and hope in the near future to be in a position to add our bit.

Dissimilarity to Service Engines Claimed

– G. H. B. Davis

Esso Laboratories, Standard Oil Development Co.

OILINESS has long been a cloak for mental laziness, and Mr. Neely is to be complimented for his work of unmasking.

In the introduction to his paper Mr. Neely expressed the hope that his work "would contribute to a better understanding of some of the theories of oiliness," and so on. Considering the dissimilarity of his apparatus compared to the operating parts of automotive engines and the questions as to whether his apparatus shows the effects of viscosity, film thickness, extreme-pressure characteristics or oiliness, I fear it is difficult to feel much nearer to a solution of the problem of oiliness and wear.

He has emphasized clearly a point that we should always bear in mind – that all materials which may be added to oils to reduce their frictional characteristics do not necessarily reduce wear. By the same token extreme care must be used in drawing conclusions from tests on one particular apparatus and applying them to an entirely different test.

Confirmation by Different Investigators Reported

– Neil MacCoull

The Texas Co.

IT is a considerable satisfaction to have brought out clearly for discussion as Mr. Neely has done in his paper, the fact that the friction and wear characteristics of lubricants are not necessarily dependent upon each other. Until recently some authors have spoken of oiliness as the ability of a lubricant to reduce wear between metallic surfaces although, more generally, oiliness is considered as the characteristic (independent of viscosity) which reduces friction. Then, too, there are those who use the term oiliness to cover all phenomena of lubrication which are not accounted for in our present state of knowledge. I am glad for this opportunity to see data presented which clearly show that, if oiliness is a measure of friction, then it does not necessarily have any connection with wear, and we must have a definition for some other quality of a lubricating oil to cover its ability to reduce wear.

Some time ago we constructed an E.P. testing machine similar to the S.A.E. machine, but hydraulically loaded so that it was a simple matter to indicate the friction during an E.P. test. We provided this machine with a modified engine indicator so as to draw curves of the relation between load and friction. We had expected that, when failure of the test specimens occurred, the much roughened surfaces would cause a sudden increase in friction. The few runs made with this device did not indicate any change in the slope of the line drawn between load and friction when "galling" occurred. This finding was somewhat similar to results reported to me by Macy Teetor who found that, in some instances, galling between flat iron specimens rubbed together actually reduced friction. This result was probably due to small particles torn off which may have acted like ball bearings between the surfaces.

It will probably be of interest to observe here that a similar disagreement between friction and wear was reported many years ago on the effect of various changes in the composition of a bearing metal. Archbutt and Deeley[a] have quoted test runs by Clamer[b] which showed that in a lead-bronze bearing, increasing the percentage of tin and decreasing the percentage of lead reduced the friction but increased the rate of wear.

This similarity between various bearing alloys and the lubricants referred to by Mr. Neely, in changing friction in the opposite direction from wear, of course, does not imply that other bearing metals as well as other lubricants do not exist which may change both the friction and wear in the same direction.

[a] See "Lubrication and Lubricants," p. 499, Griffith, London, 1927.

[b] See the *Journal of the Franklin Institute*, Vol. CLVI, July, 1903, pp. 49-77: "A Study of Alloys Suitable for Bearing Surfaces," by G. H. Clamer.

Results Seen as Guide for Additional Work

– F. A. Faville

Faville-LeVally Corp.

MR. NEELY has fairly grabbed the lion by the tail; he has thrown down a challenge. It serves as a helpful guide for additional work along these lines in our own research. If the Bureau of Standards has information that these data do not compare with actual results in the automobile engine, what are these actual results? If actual data are available, bringing out the benefit or detriment of addition agents in automobile engines, it will then be possible to modify either the testing equipment or the type of test to obtain better agreement with such test results.

The previous discussion of whether or not test pieces were in full-fluid or boundary film is the very essence of the testing problem. We know that bearings, under forced lubrication, and in true fluid film operate with almost no wear at all.

Adhesive and Cohesive Characteristics

– J. A. Moller

The Pure Oil Co.

IT is interesting to note that, although Mr. Neely has refrained from drawing definite conclusions, the nomenclature used in the conclusions that he does draw, is of interest. The same words are used in the opening paragraph of the paper and are: (1) oiliness and (2) wear.

Glancing over some of the former definitions of oiliness, three seem to stand out as expressive of the advance in research and thought on this subject.

Herschel defined oiliness as "the property that causes a difference in the friction when two lubricants, of the same viscosity at the temperature of the film, are used under identical conditions."

Note that he mentions "film" which indicates a full-fluid-film state of lubrication, rather than a state of secondary boundary in which no true film can exist as such.

Bridgeman, in December, 1933, before the Society of Rheology, said that oiliness was "that characteristic of liquids, which results in lowering of friction between surfaces moving relative to one another and which cannot be accounted for on the basis of viscosity."

Note that he mentions "viscosity" which also indicates a full-fluid-film state, rather than a state of secondary boundary since, in secondary boundary, the viscosity of the lubricant is but one of the factors affecting friction.

Hersey in his book "Theory of Lubrication" states that "The only scientific definitions prepared for oiliness are based upon the historical concept of oiliness, as a friction-reducing characteristic. It cannot be assumed without experimental evidence that the lubricant of superior oiliness will be superior to others in reducing wear or preventing seizure, except so far as the effect of frictional heat is involved. Regrettable confusion, tending to retard technical progress, might be caused by the indiscriminate use of the term oiliness for any and all meritorious characteristics of a lubricant."

Therefore, to date at least, it would appear that the general conception of oiliness is that it is a summation of friction-reducing characteristics of a lubricant under conditions of full-fluid film.

Now, if "oiliness" is a function of full-fluid-film condition, the viscosity of the lubricant between the surfaces is highly important for comparative test results. To obtain, or evaluate, the viscosity, for comparative purposes only, it would seem that, not only must the temperature of the lubricant entering the machine be controlled carefully, but that the temperature of the oil film, or at least, of the bearing surfaces,

be accurately recorded. Unfortunately, Mr. Neely's paper does not appear to give these data.

His paper deals with a machine which, from its construction, the geometrical shape of its test parts, and the description of the test procedure, would indicate that full-fluid-film conditions are, at least, not maintained throughout the tests. The straight-line relations between friction and load, and wear and load would seem to bear this point out. The question arises: Is this an "oiliness" test as "oiliness" has, to date, been defined? It would appear that it is not.

Friction and wear, resulting from speed and load conditions, are measured fairly easily. However, the interpretation of these measurements – especially if other variables, such as temperature, are not recorded exactly – is another problem.

It might be of interest to go back to the fundamentals which are so often overlooked.

The mechanical action of a lubricant is first to "wet" a surface and, second, to build up additional lubricant layers upon the "wetting" film. These characteristics may be classified as "adhesion" (wetting) and "cohesion" (molecular attraction).

In primary- and secondary-boundary lubrication, the adhesive characteristics naturally predominate.

In full-fluid film, the adhesive characteristics are important only in building the "foundation" layers, for the cohesive layers to build upon. The strength of the resulting film is, therefore, equal to the strength of the weaker of the two components. If the foundation or adhered layers fail, the structure fails, and seizure occurs. If the molecular attraction between molecules is not strong enough – if the "cohesive" characteristic fails – the state of full-fluid film cannot exist as such, but some state of secondary boundary, or even primary boundary must then exist.

This explanation is not new. Every friction curve starting from primary boundary through secondary boundary, full-fluid film – then secondary, primary and seizure would seem to bear out this analysis.

Further, many additive compounds are known which increase the adhesive characteristics of a lubricant. In a lubricating oil, they accomplish their purpose in one of two ways – first, by reducing surface tension, second, by chemical attraction. Unfortunately, both methods generally seem to lessen the attraction between the molecules within the oil, and the cohesion characteristic is partially, or totally, lost. There are some compounds which definitely do increase cohesion, or molecular attraction, between oil molecules. Metallic wear, in the accepted definition of the term, can only take place when mechanical contact exists. Therefore, metallic wear can only take place in either the primary or secondary state of friction. In studying additive compounds and wear, it would seem, quite obviously, not only from Mr. Neely's paper but, from practically all of the other work directly and indirectly related, that wear is in direct relation to the particular degree of secondary boundary friction attained. Here, it is interesting to remark that under identical conditions of test – load, speed, temperature, and so on – that different additive compounds, even though resulting in the same total friction, may result in varying wear results. The reason is that different additive compounds affect, by varying degrees, the adhesive and cohesive characteristics of the lubricant. The result is that, under identical test procedure, two additive compounds, tested individually in the same lubricant, will result in two different states of secondary boundary. The test, therefore, is not necessarily one of friction or wear but primarily of the state of friction.

In recent years, much has been said regarding additive agents, or compounds. Probably one of the earliest forms was the use of compounds with steam cylinder oils which cut the surface tension of the oil and accomplished: (1) emulsification with the steam and hence was carried into the cylinder, and (2) increased adhesion and would cling to the cylinder walls. It was then found that these oils worked well in worms and gears due to increased adhesion, because of lessened surface tension.

It must be remembered, however, that increased adhesion, however obtained, is apparently most beneficial under conditions of secondary boundary, for example, the reciprocating action of pistons, piston-rings, slide valves, and so on, although full-fluid-film conditions may be attained at some portion of each stroke, there is always at least a portion, and in many instances all of the stroke, in secondary boundary.

The resistance to the squeezing action between gears of whatever design is in this field, but that, gentlemen, is another subject.

However, the same basic underlying principles of lubrication still apply.

In conclusion, it would appear that oiliness is not a state, or a condition, of lubrication alone but, in the full-fluid-film state of lubrication, it is a summation of the necessary and desirable characteristics in a lubricant, tending to give that lubricant, first, the maximum foundation, or adhesive, layer; and, second, the maximum of cohesion, or intermolecular attraction, consistent with a minimum coefficient of friction for a given set of test or operating conditions when compared with a second lubricant under identical test conditions.

The Cost of National Defense

WE hear a cry going to the high heavens about the tremendous costs of national defense, and they are great but, as a matter of fact, such financial burdens as we have are largely due to past lack of planning.

You pay comparatively little for national defense. Your taxes for all land, air, and sea forces are about $5 per capita. In Germany, you would pay $8; in Japan, $13; in Italy, $14; in Great Britain, $15; in France, $23; and in Russia, $33; and, what is worse, you undoubtedly would be less able to afford the expenditure.

It is now a matter of history that thousands of lives were lost because of a lack of foresight and proper planning. Two million men were sent to Europe without sufficient artillery, without sufficient machine guns, without any airplanes, and the many other items so necessary for success. Some of our men were required to wear British and French uniforms because not sufficient American uniforms were available. While Germany took the lives of many of our men in France, pneumonia took the lives of thousands of our men in the United States due, in no small measure, to the inadequate housing conditions.

The conditions that are existing in Europe and Asia today should cause us to pause and analyze our situation to determine whether or not we can properly defend those principles and ideals that have been handed down to us through the centuries.

History proves that we have suffered greatly from unpreparedness. Our carelessness and our neglect have cost lives and money. Future war will include swift air attacks and scientific weapons which call for greater promptness and efficiency in defense than heretofore have been necessary. The influence of munitions upon the strategy and tactics of war is greater than written history shows.

We are endeavoring to mobilize industry because war has become a great industrial as well as a military problem, and involves not only armies but nations. It is, therefore, essential that we use our industrial powers to the utmost efficiency but, in a country such as ours, the very vastness of its resources in men, in materiel, in machinery makes the problem of preparedness difficult. Nationally we prefer to ignore the subject of war during peace but, when war is imminent, we seek scapegoats to carry the blame for our national neglect.

The World War was no exception to this national weakness. It is almost impossible to make our people understand that military resources are not the same as military strength. Even very intelligent people seem to have difficulty in visualizing the difference between materiels available in peace and those that may be necessary in war. Money, materiel and patriotic zeal after war begins cannot restore to us the precious days, weeks and months which might have been saved by intelligent planning in the quiet times of peace. We have the men. We have the materiel. We have the machinery, and we have the money necessary to defend our country, but we fail too often to realize that these must be economically organized and coordinated for war purposes, and that all four are necessary. When we realize this, we have made one of the greatest strides toward the maintenance of peace.

Excerpt from the paper: "Procurement Planning in the United States Army Air Corps," by Major Joseph L. Stromme, U. S. Army Air Corps, presented at the National Aircraft Production Meeting of the Society, Los Angeles, Calif., Oct. 8, 1937.

Hypoid Lubricants-Test Results and Their Interpretation

By C. E. Zwahl

Metallurgical Engineer, Chevrolet Motor Co.

A DETAILED report of the results obtained testing hypoid lubricants at the Chevrolet Motor Co. is presented in this paper. As a result of these tests it is announced that 182 hypoid lubricants have been put on the Chevrolet approved list.

Seeking to correct an impression that only lead soap-active sulphur and lead soap-sulphur saponifiable-chlorine lubricants would be considered, the author states that other types that meet specifications also will be put on the approved list.

Nine different characteristics are checked in the laboratory tests: load-carrying properties; viscosity; chemical analysis to determine the total lead, sulphur, and chlorine; oxidation; evaporation loss; non-combustible sediment; channeling; foaming; and copper-strip test.

Scoring tests were conducted over a 3.8-mile speed loop in the proving ground at speeds varying from 10 to 70 m.p.h., and a new third member was used for each test of each lubricant. If the lubricant prevented scoring in two tests and was free from certain undesirable characteristics as determined in the laboratory, it was considered satisfactory.

Hypoid lubricants that failed to pass the tests are analyzed. Durability tests on various hypoid lubricants covering mileages up to 40,000 are described.

THE Chevrolet Motor Co. welcomes the opportunity to present a detailed report of the results obtained testing hypoid lubricants during the past seven months. This report is divided into 15 sections:

Section I – Laboratory Tests

Laboratory tests and proving-ground scoring tests run on lubricants prior to Oct. 1, 1936, indicated quite clearly that hypoid lubricants could not be approved or rejected on results of laboratory tests alone.

Consequently, Chevrolet Motor Co. took the position that the lubricants must pass the proving-ground scoring test and must be free from certain undesirable characteristics determined by laboratory tests, to be placed on the approved list.

With reference to laboratory tests, the Chevrolet Motor Co. wishes to correct the impression, fostered by the distribution last fall of the General Motors Proposed Tentative Specifications, that only lead soap-active sulphur and lead soap-sulphur saponifiable-chlorine lubricants, specifically covered by these specifications, will be considered and tested. Chevrolet has not, and does not, limit testing to these two types of lubricants. If there are lubricants other than these two types which will satisfactorily lubricate our axles, we want to know about them and test them. If they pass the scoring test and have no objectionable characteristics, we will place them on the approved list. Further, Chevrolet does not require that lubricants meet the limits set forth in these specifications.

Data obtained by means of the following laboratory tests are not used for the purpose of approving or rejecting lubricants, but to find a relation, if possible, between laboratory tests and proving-ground scoring tests, durability tests, and service in the field.

A sample taken from each lubricant submitted is sent to the General Motors Research Laboratories for analysis. The characteristics determined are:

(1) *Load Carrying Properties* of the lubricant as received, using the SAE Extreme-Pressure Lubricant Testing Machine under the following conditions:

Speed	750 r.p.m.
Rubbing ratio	14.6:1
Loading rate	83.5 lb. per sec.

The load-carrying properties after heating 200 cc. of the lubricant in a 400-cc. beaker for 16 hr. in an oven at 180 deg. fahr., using the SAE Extreme Pressure Lubricant Testing Machine under the preceding conditions and, in some cases, under the following conditions:

Speed	550 r.p.m.
Rubbing ratio	14.6:1
Loading rate	83.5 lb. per sec.

(2) *Viscosity* – Saybolt Universal at 210 deg. fahr.

(3) *Chemical Analyses* to determine the total lead (calculated as lead oxide – PbO) sulphur, and chlorine.

(4) *Oxidation* – reported as percentage increase in the viscosity at 210 deg. fahr., Saybolt Universal, after heating 200 cc. of the lubricant in a 400-cc. beaker for 100 hr. at 300 deg. fahr. in an oven without fan or forced ventilation.

[This paper was presented at the Chicago Section Meeting of the Society, Chicago, Ill., April 6, 1937.]

(5) *Evaporation Loss* – Reported as the percentage loss on evaporation in the oxidation test described in item (4).

(6) *Non-Combustible Sediment* – Obtained in the following manner: "Separate the sediment in the manner described for the water and sediment determination, A.S.T.M. D96-35. Syphon off the oil and benzol and wash sediment into a dish with benzol, using a tuft of absorbent cotton to remove the last traces of sediment from the centrifuge tube if necessary. Evaporate benzol, ignite, and weigh. The residue constitutes the non-combustible sediment."

(7) *Channeling* – Ordinarily a small beaker of the lubricant is placed in the cold room and cooled to 0 deg. fahr. After it is thoroughly cooled, it is examined and a rather crude test made by pushing a finger or a stick through it to see if it channels or is excessively thick. If the lubricant channels or appears to be excessively thick, it is tested in an axle in the cold room. The housing cover of the axle is cut in half to permit observation, the lubricant placed in the housing, the half cover attached, and thermocouples inserted into the lubricant. The set-up is allowed to cool until the lubricant registers 0 deg. fahr. The gears are then revolved by means of a crank attached to the end of the propeller shaft.

(8) *Foaming* – Using a Model 1, Sunbeam Mixmaster equipped with a pan 7 in. in diameter, 3¼ in. deep, supported on the turntable mounted in the center bearing. The increase in volume when 500 cc. of lubricant are churned for 15 min. (No. 4 speed) is measured after standing 1 hr.

(9) *Copper Strip Test* – By immersing a clean polished strip of copper in the lubricant for 5 min. at room temperature. The degree of attack is reported as positive, positive-mild, slight, negligible, and none.

Section II – Scoring-Test Procedure

After supplying the laboratory with enough of the lubricant for their tests, the remainder of the lubricant submitted is sent to the proving grounds and subject to the scoring test, the procedure being as follows:

(1) Axle housing, axles, and so on, are cleaned thoroughly to remove oil other than the type to be tested.

(2) A new third member is installed, and the housing filled with the lubricant to be tested.

(3) One lap of the speed loop (3.8 miles) at 60 m.p.h. and one lap at 70 m.p.h. Axle checked for noise on the east-west straight-away (a level, concrete pavement) on the drive and coast – 10 to 40 m.p.h. and 40 to 10 m.p.h. in high gear.

(4) Ten laps of the speed loop (total 38 miles) at 75 m.p.h.

(5) Noise check as in Item No. 3.

(6) Car taken to the garage, lubricant drained into clean container, axle housing cover removed, and the gears inspected.

If the gears appear to be O.K., the cover is replaced and the housing refilled with the drained lubricant. The car is driven to the east-west straight-away and the testing proceeds:

(7) Car is speeded up in high gear to 70 m.p.h., then clutch is disengaged and ignition turned off. The car is permitted to coast until speed registers 65 m.p.h. when the clutch is engaged as rapidly as possible with transmission in high gear – with ignition turned off. The car, with clutch engaged – ignition turned off – is permitted to coast down to 40 m.p.h.

(8) The procedure outlined in Item No. 7 is performed seven times.

(9) Noise check as in Item No. 3.

(10) The procedure outlined in Item No. 7 is performed an additional eight times. (This makes a total of fifteen shocks in high gear.)

(11) Noise check as in Item No. 3.

(12) The car is speeded up to 50 m.p.h. in second gear, then clutch is disengaged and ignition turned off. The car is permitted to coast until speed registers 45 m.p.h. when the clutch is engaged as rapidly as possible with transmission in second gear – with ignition turned off. The car, with clutch engaged and the ignition turned off, is permitted to coast down to 20 m.p.h.

(13) The procedure outlined in Item No. 12 is performed five times.

(14) Noise check as in Item No. 3.

(15) Procedure outlined in Item No. 12 is performed an additional five times. (This makes a total of ten shocks in second gear.)

(16) Noise check as in Item No. 3.

(17) Car driven to garage, third member removed from axle, and the gears inspected.

(18) Third member is tagged and sent to the axle plant where it is checked thoroughly and examined.

Remarks: A new third member is used for each test of each lubricant.

Examination of the gears may be made at any time during the preceding test if the observers believe the gears to have scored or the axle to have become objectionably noisy. This inspection is made by returning the car to the garage, draining the lubricant into a clean container, and removing the housing cover. The third member is not removed.

If the gears are scored, the test is discontinued immediately and the lubricant is given no further consideration.

If the gears are not scored after the preceding scoring test, a second third member with a fresh refill of the same lubricant in the thoroughly cleaned housing is tested similarly.

If the lubricant prevents scoring on the two tests and certain characteristics, determined by laboratory, are satisfactory, it is considered satisfactory.

No further consideration is given a lubricant which permits scoring during either of the two tests. If scoring occurs during the first test, a second test is not made.

Section III – Summary

Total lubricants approved (U. S. and Canada)	182
Lubricants approved – Canadian	21
Rebranded lubricants approved	129
Lubricants tested at proving grounds	111
Lubricants passing proving-ground tests – total	70
Lubricants passing proving-ground tests – experimental or being held for further testing	10
Rebranded lubricants tested and passing proving-ground tests	4
Lubricants passing proving-ground tests – rejected on laboratory results	4
Lubricants approved on passing proving-ground tests	52
Lubricants failing on proving-ground tests and not approved	41
Lubricants tested in laboratory	115
Lubricants not approved on laboratory tests – no proving-ground tests made	2

Section IV – Rebranded Lubricants

List of Companies Supplying Distributors. – The report from which the data contained in this paper were taken lists the names of companies supplying lubricants to distributors who sell under their own brand names.

This list, for obvious reasons, will not be a part of this paper.

Section V – Lubricants Passing Scoring Test

Lead soap-active sulphur lubricants	62
Lead soap-sulphur saponifiable-chlorine lubricants	3
Sulphurized oil lubricants	5

And one special mixture consisting of two-thirds lead-soap-active sulphur lubricant and one-third 10-W motor oil (by volume) tested to ascertain the effect of dilution.

Section VI – Lubricants Failing Scoring Test

Mild-type lead soap-sulphur saponifiable-chlorine lubricants	2
Lead soap lubricants with no sulphur and lead soap-sulphur saponifiable lubricants, and lead soap lubricants with very small amounts of active sulphur	15
Sulphur-saponifiable lubricants	7
Chlorinated lubricants	13
Chlorine-sulphur lubricants	2
Lubricant containing insoluble zinc oxide and soluble lead	1
Mineral oil submitted as an extreme-pressure lubricant	1

It is of interest to note where, in the scoring test, the preceding lubricants failed.

The two mild-type lead soap-sulphur saponifiable-chlorine lubricants failed during the ten laps of the speed loop. The axles were not subject to shock tests.

Nine of the fifteen "lead soap lubricants with no sulphur, and lead soap-sulphur saponifiable lubricants, and lead soap lubricants with very small amounts of active sulphur" failed during the ten laps of the speed loop. The axles were not subject to shock tests.

Five of the seven sulphur-saponifiable lubricants failed during the ten laps of the speed loop. The axles were not subject to shock tests.

Eleven of the thirteen chlorinated lubricants failed during the ten laps of the speed loop; the other two failed during the two "warm-up" laps of the speed loop at the beginning of the test procedure. None of these axles was subject to shock tests.

One of the two chlorine-sulphur lubricants failed during the ten laps of the speed loop. The axles were not subject to shock tests.

The lubricant containing zinc oxide and lead failed during the two "warm-up" laps of the speed loop. This axle was not shock-tested.

The lubricant submitted as an extreme-pressure hypoid lubricant, but which turned out to be ordinary mineral oil, failed badly while driving from the garage to the speed loop – about ½ mile. The scoring test was not started on this lubricant.

Thus, 33 of the 41 lubricants which failed to pass the scoring test failed before the shock-test portion of the procedure was reached.

Of the eight lubricants which "got by" the ten laps of the speed loop, six failed during the high gear shocks and two during the first portion of the second gear shocks. Two of these eight lubricants were sulphur saponifiable lubricants, one was a chlorine-sulphur lubricant, and five came under the classification of "lead soap lubricants with no sulphur, and lead soap-sulphur saponifiable lubricants, and lead soap lubricants with very small amounts of active sulphur."

Section VII – Miscellaneous Lubricants

Lubricants Passing Proving-Ground Scoring Test and Not Approved – Experimental Held for Further Testing, Rejected on Laboratory Results. – A total of fourteen lubricants passing the proving-ground scoring test have not been approved.

Six are experimental lubricants.

Four are sulphurized oil lubricants which are being tested further to determine if they may cause corrosion of the steel parts of the axles.

Four were rejected definitely on laboratory test results. One of the four foamed excessively in the laboratory and in the axle during our scoring testing; one channeled badly at zero; one had a viscosity of 212 sec. at 210 deg. fahr. and was very thick at zero; and the fourth showed excessive non-combustible sediment.

Section VIII – Rejected in Laboratory

Two sulphur-saponifiable lubricants were rejected on the results of laboratory tests, not being subjected to the proving-ground scoring test.

Section IX – Conclusions from Scoring Tests

(1) To date only lead soap-active sulphur and lead soap-sulphur saponifiable-chlorine lubricants have passed our proving-ground scoring tests and been placed on our approved list. Four sulphurized lubricants have passed the proving ground scoring test, but have not been placed on the approved list.

(2) The scoring test, requiring a mileage of 80 on an average, cannot be used to determine the stability of hypoid lubricants.

Section X – Secondary Lubricant Tests

Six or seven months ago the lubrication of hypoid axles in the field was a much more serious problem than it is today. At that time lubricants which, according to our tests, would lubricate our hypoid axles satisfactorily were few in number and had little or no distribution, nor had we any assurance that satisfactory lubricants would be distributed.

We were inclined to the belief that the axles "broken-in" or "run-in" with a "powerful" type of hypoid lubricant, with which the axle housing would be filled at the factory, could be lubricated subsequently with the mild-type extreme pressure lubricants or, possibly, with mineral oil. Both types of lubricants had country-wide distribution.

Tests were made at the proving grounds using a lead soap-active sulphur and a lead soap-sulphur saponifiable-chlorine lubricant as the "breaking-in" or "primary" lubricant. Various types of "mild" extreme-pressure lubricants, then on the market, were used as the "refill" or "secondary" lubricants. Mineral oil as a "secondary" lubricant was also tested.

Axles were run various mileages using the foregoing "primary" lubricants, drained – not flushed nor the housing cleaned out – and refilled with the "secondary" lubricant. The results were notable for their inconsistency. The longer mileage of breaking-in with the "primary" lubricants, in most cases, merely postponed for a short time the failure of the gears.

It is quite possible that many of the Chevrolet hypoid axles, after being "broken-in" with the factory lubricant, may be lubricated satisfactorily with lubricants which do not pass our tests. On the other hand, many axles, due to the service to which they are subjected, will require an approved lubricant for satisfactory service and probably will fail if such lubricant is not used.

Chevrolet will hear about those axles which fail, and not of those which perform satisfactorily. Consider Chevrolet's production, and you will realize readily that small percentage figures mean a considerable number of cars.

In view of the contradictory results obtained on these tests, Chevrolet can only approve and recommend for "refilling," those lubricants which we believe will lubricate satisfactorily the axles under any and all service conditions. Such lubricants, in our opinion, must pass our tests.

Section XI – Comments on Laboratory Tests

Load-Carrying Properties of Lubricants As Received and After Heating for 16 Hr. at 180 deg. fahr. – SAE Extreme-Pressure Lubricant-Testing Machine. – A very considerable number of tests were made and the results, tabulated for each type of lubricant, are a part of our records. The following are conclusions to be drawn from these data:

Lead soap-active sulphur lubricants showed the most consistent results, all of the 62 tested sustaining the full load at 750 r.p.m. before heating. Five of the lubricants showed a decrease in their load-carrying properties at 750 r.p.m. after heating but sustained the full load at 500 r.p.m. All of these lubricants passed the proving-ground scoring test.

The lead soap-sulphur saponifiable-chlorine lubricants showed widely varying results – as low as 34 lb. to as high as the full load at 750 r.p.m. However, the lubricants of this type passed the proving-ground scoring test. One lubricant of this type was used in all of the experimental axles tested in proving-ground and engineers' test cars and has been used in production.

We have yet to have our first failure of an axle lubricated with either a lead soap-active sulphur lubricant or the lead soap-sulphur saponifiable-chlorine lubricant. However, lead soap lubricants too low in active sulphur showed low SAE Machine results and permitted scoring of the gear teeth in the proving-ground scoring test.

SAE Machine results on the other types of lubricants also varied widely.

It is our opinion that SAE Machine results, considered alone, cannot be used as a basis for making a decision to approve or not to approve hypoid lubricants.

Considered with the analysis of the lubricant and with past experience testing lubricants of the same type in axles, predictions as to performance in axles can be made with a considerable degree of accuracy.

Nevertheless, we feel that a lubricant submitted for test should be subjected to our scoring test before it is approved or not approved.

Viscosity

Saybolt Universal viscosities at 210 deg. fahr. of 82 of the 92 lubricants reported by the laboratory, were between 70 and 99 sec., and of 61, between 80 and 89 sec.

Chevrolet Motor Co., in its instruction books, recommends the use of the SAE 90 grade the year around. SAE 80 grade, not mentioned in the present books, is recommended for those sections of the country and Canada having extremely cold weather during the winter months and will be so mentioned in future instruction books.

Chevrolet will continue to recommend SAE 90 and SAE 80 grades. Hypoid lubricants for factory use probably will be specified 80-90 sec. at 210 deg. fahr., and not over 1,000,000 sec. at 0 deg. fahr. It is possible that we may lower the 1,000,000-sec. requirement to 750,000 sec. to provide a greater fluidity factor of safety.

Chemical Analyses – Lead

The lead content of the lead soap-active sulphur lubricants passing the proving-ground scoring test, calculated as lead oxide (PbO), ranged from 0.81 per cent to 6.19 per cent:

1	lubricant under	1 per cent
21	lubricants from	1 to 2 per cent
26	lubricants from	2 to 3 per cent
10	lubricants from	3 to 4 per cent
1	lubricant from	4 to 5 per cent
2	lubricants from	5 to 6 per cent
1	lubricant from	6 to 7 per cent

Fifteen lubricants containing lead soap but not passing the proving-ground scoring test, showed the lead oxide to be over approximately the same range but, due to low active sulphur, permitted scoring of the gear teeth.

General Motors Proposed Tentative Specifications for lead soap-active sulphur lubricant require that the lead, calculated as lead oxide (PbO), shall be from 1 to 4 per cent. We see no reason to change this requirement.

In the past there has been some complaint regarding separation of the lead soap, especially in storage. Such separation depends upon two factors: (1) the solvent power of the mineral oil used in making the lubricant, and (2) the solubility of the lead soap.

As regards the first factor, oils of the napthenic type will, in general, hold lead soaps in solution better than paraffinic types.

Of the lead soaps, lead napthenate, which is coming into general use, is very much more soluble than the lead oleate which was used in the past and, to a limited extent, at the present time.

By the proper combining of these two factors non-separating lead soap lubricants are made and are in general use.

There are two very good reasons for using lead soap:

(1) Lead soap is an inhibitor of corrosion of steel in the presence of water.

(2) Lead soap, especially under the more severe operating conditions, adds to the lubricating ability of the lubricant.

Chemical Analyses – Sulphur

The total sulphur content of the lubricants varied widely. The laboratory has not completed sulphur determinations on all of the lubricants. Those reported range as follows:

Under 1 per cent	15
1-2 per cent	30
2-3 per cent	28
3-4 per cent	11
4-5 per cent	1
5-6 per cent	2

Sulphur, in the lead soap-active sulphur lubricants, is the material which provides the load-carrying ability; at least, until the very severe operations are reached when the lead soap also aids.

Lead soap without sulphur will not lubricate Chevrolet hypoid gears.

Sulphur without lead soap will lubricate Chevrolet hypoid gears, but the lead soap is very desirable as it is a corrosion inhibitor and also aids in the lubrication.

General Motors Proposed Tentative Specifications give limits of 0.75 to 2.00 per cent for added sulphur. When sulphur is combined with mineral oil, some is combined so firmly that it is of no value in increasing the load-carrying ability of the lubricant.

The principal trouble which we have encountered with lead soap-active sulphur lubricants has been the fact that the active sulphur in some of the lubricants has been too low. Increasing the active sulphur solves the difficulties.

Any change in specifications probably would be the raising of the lower limit of the sulphur and, as in the previously mentioned specifications, the limits apply to the sum of the sulphur plus chlorine and not to sulphur only, it may be found desirable to specify minimum and maximum limits for the sulphur and for the chlorine.

Chemical Analyses – Chlorine

Chlorine content of several of the lubricants submitted ranged from 0.21 per cent to 5.26 per cent.

At the present time sulphur is in almost universal use as

the material added to the lead soap. Some manufacturers are endeavoring to replace sulphur partially or entirely by chlorine and there is at least one lubricant of this class used commercially.

Oxidation

Oxidation is reported as the percentage increase in the Saybolt Universal viscosity at 210 deg. fahr., after heating 200 cc. of the lubricant in a 400-cc. beaker for 100 hr. at 300 deg. fahr. in an oven without fan or forced ventilation.

Results obtained by this test are considered as indicative of the thickening tendencies of the lubricant and, to some extent, as a measure of the stability of the lubricant.

General Motors Proposed Tentative Specifications require that the viscosity increase shall not be more than 50 per cent.

Although we believe that a lubricant showing a low viscosity increase is a better lubricant than one that shows a high viscosity increase, we believe that lubricants that would perform satisfactorily in axles will be rejected if results as determined by this method are used as a basis for approval or rejection.

We have run axles 20,000 to 50,000 miles with a lubricant showing a viscosity increase of 150 per cent by this method. The gears, bearings, and so on, were examined thoroughly and were in excellent condition. No indication of sludge could be found. Laboratory investigations of the lubricant disclosed no increase in the viscosity; the SAE Machine properties were the same, and the lead soap and sulphur contents were practically unchanged. In each case the original filling remained in the axle from start to finish, with no additions.

In view of our results in axles in service, we are inclined to feel that the method for this test should be modified.

Laboratory oxidation test results showed 83 of the 92 lubricants tested to have viscosity increases of less than 50 per cent; 3 were between 50 and 59 per cent; 3 between 60 and 100 per cent; and 3 between 100 and 153 per cent. 73 of the 83 were below 30 per cent increase in viscosity.

Evaporation

The General Motors Proposed Tentative Specifications require that "the loss on evaporation in the oxidation test shall not be over 15 per cent."

As lowering of the lubricant level in an axle housing may result in the failure of the axle due to lack of lubricant where needed, it is obvious that lubricants should be made so that their loss by evaporation is very small. It is possible that the 15 per cent requirement may be too high or too low. Possibly the 300 deg. fahr. temperature used in the oxidation test is too high and the results so obtained are misleading.

These points cannot be settled definitely until we have had more field experience.

Laboratory results on 92 of 95 lubricants tested showed under 15 per cent loss by evaporation. The other 3 showed evaporation losses between 15 and 20 per cent.

Non-Combustible Sediment

It is our opinion that the amount of non-combustible sediment present in a lubricant is of the utmost importance. Particular pains should be taken by the lubricant manufacturers to keep it as low as possible.

The General Motors Proposed Tentative Specifications specify non-combustible sediment shall not be over 0.08 per cent. We believe this figure should be lower – say 0.05 per cent.

Non-combustible sediment has been reported on 98 lubricants by the laboratory. 79 showed less than 0.08 per cent and 74 of these were under 0.05 per cent. The remaining 19 ranged from 0.08 per cent to 1.24 per cent.

Channeling

The General Motors Proposed Tentative Specifications require that "the lubricant shall not channel in rear axles under service conditions at 0 deg. fahr."

The necessity for the lubricant to flow freely or, at least, not to channel, leaving the gears free of oil at low temperatures, is obvious.

Lubricants tested to date which channeled or became excessively thick at zero have not been approved even though they passed the proving-ground scoring test.

Foaming

The General Motors Proposed Tentative Specifications require that "the increase in volume when 500 cc. of lubricant are churned for 15 min. shall not exceed 100 cc. after standing for 1 hr." (Refer to laboratory tests – Item No. 8, Section I, of this report.)

Foaming tests were made on many of the lubricants, and the results showed a considerable range.

It is obvious that a lubricant which foams excessively in an axle under service conditions should not be used. However, we do not know if the results obtained by the method outlined in the General Motors Proposed Tentative Specifications are a true indication of the foaming tendencies of the lubricants when used in axles.

With one exception, lubricants showing high foaming results by the preceding method in the laboratory showed little or no foaming in the axles when put through the scoring test. Too much emphasis should not be given this statement as the scoring test is a short mileage test, and conditions during the test may be such that will not be conducive to foaming.

Section XII – Service Temperatures

The housing cover and under side of the differential carrier of the rear axle of a 1937 car, running on the durability schedule at the proving grounds, was drilled and tapped for ⅛-in. pipe threads in order to install thermocouples:

(1) Midway between the filler hole and bottom of the cover, approximately ½ in. inside cover and 7/16 in. to the right of the ring-gear.

(2) Between the pinion and ring-gear, approximately 7/16 in. below the pinion and 7/16 in. to the right of the ring-gear.

This car was equipped with a 4.22:1 ratio axle and lubricated with a lead soap-sulphur saponifiable-chlorine lubricant. With an air temperature of 77 deg. fahr., the lubricant showed temperatures ranging from 157 to 166 deg. fahr. inside the housing cover and 159 to 169 deg. fahr. between the pinion and ring-gear.

One of a number of cars taken to Texas for test purposes was equipped with thermocouples to measure the temperatures of the rear-axle lubricant.

This car was equipped with a 4.22:1 ratio hypoid axle and lubricated with the production lead soap-active sulphur lubricant.

Enroute to Texas, temperatures, not stabilized at any constant speed, were obtained and are temperatures of the lubricant in actual traffic conditions between cities.

Air temperatures ranged from 64 to 82 deg. fahr.; the speed of the car, from 50 to 80 m.p.h.; and the lengths of the runs during which temperatures were recorded were from 37 to 116 miles. The lubricant showed temperatures ranging from 154 to 184 deg. fahr.

Constant speed checks were made at Victoria, Tex., Oct. 1 and 2, 1936. The road, used for test purposes, was 12 miles

long, running north and south. The car was driven at a designated speed in one direction, turned and driven in the opposite direction and, finally, turned and driven in the same direction as in the first run. A north-northwest wind of approximately 12 m.p.h. was encountered during the tests. The production lead soap-active sulphur lubricant was used. The results of three test runs follow:

	Air Temperature, deg. fahr.	Car Speed, m.p.h.	Maximum Temperature of Lubricant, deg. fahr.
Test No. 1	76	80.5	197
Test No. 2	79.5	81.0	198
Test No. 3	81	81.0	197

As the lubricant temperatures continued to rise with mileage regardless of direction, the foregoing values are given as maximum during the test run.

Temperature of the lubricant, undoubtedly, would be higher when air temperatures reach the summer conditions; therefore, the preceding temperatures are probably 20 to 25 deg. fahr. below the maximum to be expected under the most severe operating conditions.

Section XIII – Durability Tests

These tests consist of running axles, lubricated with hypoid lubricants:

(1) In proving-ground test cars for 20,000 miles or more. High mileages on these cars are obtained in relatively short periods of time.

(2) In engineers' cars which require considerably longer periods of time to obtain high mileages.

When tests are completed, the axles are removed and checked by the Axle Plant, disassembled, and the condition of the gears, bearings, and so on, is ascertained. Whenever possible, a sample of the lubricant is obtained and sent to the laboratory for complete investigation.

The proving-ground durability tests were made with 1937 production cars and necessarily were not started until approximately Nov. 1, 1936. As a result, our proving-ground durability test data cover running during the fall and winter months only. However, durability tests on lubricants in the engineers' cars were started as early as April 20, 1936, using experimental hypoid axles, and were operated through the summer months.

Results of Durability Tests

Proving-Ground Cars. – Nine axles run in proving-ground test cars have been disassembled and examined to date: Mileages were 20,083; 20,121; 20,126; 20,151; 25,000; and 39,611; using the production lead soap-active sulphur lubricant. Four of the axles were 4.22:1 ratio and two were 3.727:1 ratio.

Mileage was 21,000 on an axle lubricated with a lead soap-active sulphur lubricant other than that used in production – 4.22:1 ratio axle.

Mileages were 21,424 and 43,153 using the production lead soap-sulphur saponifiable-chlorine lubricant. One axle was 4.22:1, and one 3.727:1 ratio.

The teeth of the ring-gears and pinions in all of the axles were in excellent condition – not scored. The tool marks were still quite apparent.

All of the differential and pinion bearings were cut in two, examined, and reported by the Axle Plant as being in excellent condition.

There were no indications of sludge. Axle adjustment was found by the Axle Plant to be within the limits set up for new axles.

Laboratory investigation of the lubricants disclosed that no discernible change had occurred. The viscosity had not increased and the lead-soap, sulphur, and chlorine content was practically the same as in the lubricant at the beginning of the tests. The original fillings remained in the axles throughout the tests.

Six of the foregoing axles have had new bearings installed, to replace those cut up for examination and have been reinstalled in test cars and are again running at the proving ground.

One axle with a mileage of 21,452, lubricated with the production lead soap-sulphur saponifiable-chlorine lubricant, was examined at the proving ground, without removing and disassembling the axle. The gear teeth were in excellent condition and there was no indications of sludging. The bearings could not be examined.

In addition to this axle, there are nine other axles being tested which, to date, have been run for relatively low mileages.

Engineers' Cars. – The mileages on the lubricants used in the engineers' cars are not very high considering the length of the period of time in operation. The test starting date and mileages follow:

Started	Axle Ratio	Lubricant	Mileage to Date
4-20-36	4.22:1	Lead soap-active sulphur	13,288
4-22-36	4.22:1	Lead soap-active sulphur	20,322
6-27-36	4.22:1	Lead soap-sulphur saponifiable-chlorine	10,722
7- 2-36	3.727:1	Lead soap-sulphur saponifiable-chlorine	12,811
7- 8-36	4.22:1	Lead soap-active sulphur	14,593

None of the axles in the foregoing cars has been disassembled. Examinations were made by removing the housing covers.

The gears appear to be in excellent condition, and no indications of sludging could be found. The axles' noise was checked and found to be negligible.

Samples of the lubricant in the axles of the two cars started on test during April, 1936, were sent to the laboratory for investigation. The laboratory reports no change in viscosity, lead soap and sulphur content, and that both lubricants sustain the full load on the SAE Machine.

Four additional cars on which tests were started in November, 1936, are also in operation. The mileages to date are quite low, and no inspections have been made.

Incidentally, the Pontiac Motor Co. lubricated two axles – not hypoid – with a lead soap-active sulphur lubricant, running one car 25,000 miles and the other 45,000 miles. Laboratory investigation disclosed no changes in the lubricants.

Section XIV – Hypoid Transmission Lubricants

During the early part of November, 1936, two test cars at the proving ground were equipped with new transmissions and the housings filled with a lead soap-active sulphur lubricant. We desired to ascertain if a so-called "corrosive-type" lubricant would affect the ferrous and non-ferrous parts or in any way affect the operation of the mechanism.

One transmission has run 13,702 miles and stood 76 days filled with lubricant. The bronze and brass parts are "thoroughly black but show no corrosion. The steel wearing surfaces are in better condition than is ordinarily encountered in transmissions operating with regular lubricant. This condition is especially true of counter-gear thrust washers which have steel chips imbedded but are not worn or scored."

The second transmission has run 17,550 miles and stood 73 days filled with lubricant. "All bronze parts are black but show no corrosion. The steel wearing surfaces are in better condition than those ordinarily encountered in transmissions operating with regular lubricant (S.A.E. 90 mineral oil).

Thrust washers are imbedded with chips but are not worn or scored."

No change in the operation of the transmission could be noticed. Shifting is very good, as is synchronization.

In addition to the preceding, the transmissions of the cars of two of our engineers are being lubricated with a lead soap-active sulphur lubricant. Mileages of 5500 and 6000 have been attained to date. As these transmissions have not been inspected we cannot, at this time, report their condition.

These limited tests seem to indicate that we should not expect any difficulties with transmissions lubricated with lead soap-active sulphur hypoid lubricants. The passenger-car universal joints are lubricated from the transmission, and their appearance in the preceding cars is a definite improvement over that when lubricated with mineral oil. Chevrolet is not, however, making this statement as a recommendation as we feel we cannot make a decision of this importance on tests in only two transmissions. Some transmissions which have bronze parts of certain chemical compositions might possibly be affected to an injurious degree. Our present recommendation is not to use any type of hypoid lubricant in transmissions.

The Texas test car, previously mentioned, also was equipped with thermocouples to measure the temperatures of the transmission lubricant.

The transmission was lubricated with a lead soap-active sulphur lubricant.

Enroute to Texas temperatures, not stabilized at any constant speed, were obtained and are temperatures of the lubricant in actual traffic conditions between cities.

Under the conditions obtained when axle lubricant temperatures were measured, the transmission lubricant showed temperatures ranging from 155 to 173 deg. fahr. Constant-speed checks were made at Victoria, Tex., Oct. 1 and 2, 1936, under the same conditions and at the same time that the rear-axle lubricant temperatures were obtained.

The production lead soap-active sulphur lubricant was used. Three tests were made and the following results obtained:

	Air Temperature, deg. fahr.	Car Speed, m.p.h.	Maximum Temperature of Lubricant, deg. fahr.
Test No. 1	76.0	80.5	183
Test No. 2	79.5	81.0	183
Test No. 3	81.0	81.0	183

Like the rear-axle lubricant, the transmission lubricant temperatures continued to rise with mileage regardless of direction and the foregoing are given as maximum during the test runs. The temperature of the lubricant undoubtedly would be higher when the air temperatures reach the summer conditions, therefore, the preceding temperatures are probably 20 to 25 deg. fahr. below the maximum to be expected under the most severe operating conditions.

Section XV – Axle Field Performance

The durability tests, described in Section XIII, indicate that we should expect no trouble due to the lubricant with 1937 hypoid axles in the field. This result, to date, has been borne out by reports from the Chevrolet Service Department and the General Motors Fleet Sales Corp.

These two sources of information advise that "we have no trouble with Chevrolet hypoid axles."

It is true that this period of time covers only six months and the mileages are, in many cases, very small. Nevertheless, 1937 axle complaints compared with previous-model axle complaints for the same period of time are so small in number that they are negligible.

It is also true that probably all of these axles have been, and are being, lubricated with the lubricants placed in the housings at the factory or by the Chevrolet dealers who were supplied with a lubricant by the Chevrolet Motor Co. It is quite possible that the number of complaints may increase when refill lubricants are used. We do not think so if the lubricants appearing on our approved list are used.

We feel that the field performance to date indicates, to a small degree at least, that the use of lubricants passing our tests will permit satisfactory service of the axles in the hands of the car owners.

Such lubricants, to date, have been the lead soap-active sulphur and the lead soap-sulphur saponifiable-chlorine lubricants.

Only time will disclose just what the trend in hypoid lubricants will be. The lead soap-active sulphur lubricants are giving such good account of themselves in service that a real advantage in some other material must be developed before these lubricants will be replaced.

From our standpoint, we are interested in the best results and are not taking any arbitrary stand that may block progress, regardless of the direction in which progress may lie.

Detail Data

Load-Carrying Properties of Lubricants as Received and After Heating 16 Hr. at 180 Deg. Fahr. – SAE Extreme-Pressure Lubricant-Testing Machine.

(A) – *Lead Soap-Active Sulphur Lubricants.* – 62 lubricants of this type were tested on the SAE Machine. All sustained the full load at 750 r.p.m. before heating.

The lubricants were heated 16 hr. at 180 deg. fahr. and the following results obtained on the SAE Machine:

Five lubricants showed a decrease in their load-carrying properties after heating. One dropped to 370 lb., one to 312 lb., one to 294 lb., one to 380 lb., and one to 440 lb. at 750 r.p.m. from the full load at 750 r.p.m. on the same sample before heating. These five lubricants sustained the full load at 500 r.p.m. after heating all tests. The remaining 57 sustained the full load at 750 r.p.m.

All lead soap-active sulphur lubricants passed the proving-ground scoring test.

(B) – *Lead Soap-Sulphur Saponifiable-Chlorine Lubricants.* – Three lubricants of this type were tested, all being supplied by the same manufacturer. Two of the lubricants, before heating, showed widely varying results on the SAE Machine, ranging from as low as 34 lb. to 500 lb. at 750 r.p.m. The third lubricant sustained the full load.

The lubricants were then heated 16 hr. at 180 deg. fahr. and one, which sustained 34 and 100 lb. before heating, sustained 434 lb. after heating at 750 r.p.m., and one which sustained 318 and 350 lb. before heating dropped to 64 and 96 lb. after heating at 750 r.p.m. (390 lb. at 500 r.p.m.).

The third lubricant of this type, which sustained the full load before heating, dropped to 370 lb. at 750 r.p.m. after heating (sustained full load at 500 r.p.m.).

These three lubricants passed the proving-ground scoring test. Two of these lubricants have been shock-tested numerous times, one of them being used to lubricate all experimental Chevrolet hypoid axles in proving ground and engineers' test cars. There has not, to date, been a failure of a Chevrolet hypoid axle, in our test cars, lubricated with this type of lubricant.

(C) – *Mild Type Lead Soap-Sulphur Saponifiable-Chlorine Lubricants.* – Two lubricants of this type were tested. Both showed low results on the SAE Machine, one sustaining 108 lb. and the other 76 and 92 lb. at 750 r.p.m. before heating.

After heating 16 hr. at 180 deg. fahr., one decreased in load-carrying properties from 108 lb. before heating to 72 lb.; the other increased from the 76 and 92 lb. before heating to 110 lb. after heating.

Both lubricants permitted very bad scoring of the gear teeth during the ten laps of the speed loop at 75 m.p.h. (See scoring-test procedure – Section II of this report.)

(D) – *Lead-Soap Lubricants with No Sulphur and Lead Soap-Sulphur Saponifiable Lubricants, and Lead Soap Lubricants with Very Small Amounts of Active Sulphur.* – Fourteen lubricants of the foregoing types were tested.

Six of these lubricants, before heating, sustained less than 100 lb. load at 750 r.p.m. on the SAE Machine. Heating the lubricants for 16 hr. at 180 deg. fahr. resulted in decreasing the load-carrying properties at 750 r.p.m. of one from 72 and 90 lb. to 50 lb.; one from 70 and 76 lb. to 60 lb.; one from 80 and 102 lb. to 80 lb.; and one from 60 and 70 lb. to 52 lb. Heating increased the load-carrying properties at 750 r.p.m. of one lubricant from 30 and 46 lb. to 62 lb., whereas the sixth really did not change, sustaining 46 and 56 lb. at 750 r.p.m. before heating and 50 lb. after heating.

All of these lubricants permitted bad scoring during the ten laps of the speed loop.

One lubricant sustaining loads at 750 r.p.m. of 68 and 64 lb. before heating and 44 lb. after heating permitted very bad scoring during the two "warm-up" laps of the speed loop – (one lap at 60 m.p.h. and one lap at 70 m.p.h.).

Another lubricant sustaining 18 and 36 lb. at 750 r.p.m. before heating (no SAE Machine tests after heating made) permitted "incipient" scoring during the ten laps of the speed loop and bad scoring during the first seven shocks in high gear.

The ninth lubricant with loads under 100 lb. at 750 r.p.m. before heating (no SAE Machine tests after heating made) prevented scoring during the ten laps of the speed loop but permitted bad scoring after one shock in high gear.

The tenth lubricant with SAE Machine loads at 750 r.p.m. of 110 lb. full load and full load (3 tests) before heating and 260 lb. after heating, prevented scoring during the ten laps of the speed loop, but permitted scoring during the high gear shock tests.

The eleventh lubricant sustaining loads at 750 r.p.m. of 494 lb., full load, full load and full load (4 tests) before heating, and dropping to 324 lb. after heating acted similarly to No. 10; prevented scoring during the ten laps of speed loop but permitted bad scoring during the high gear shock tests.

Lubricant No. 12 was somewhat similar to No. 10 and No. 11, sustaining loads at 750 r.p.m. of 424 and 390 lb. before heating and 374 lb. after heating; prevented scoring during the ten laps of the speed loop but permitted bad scoring during the high gear shock tests.

Lubricants No. 13 and No. 14 differ from the preceding. No. 13 sustained loads at 750 r.p.m. of 320, 112, 284 and 268 lb. before heating and increased in load-carrying properties after heating to sustain the full load of the machine. No. 14 sustained the full load at 750 r.p.m. of the machine before heating but dropped to 316 lb. after heating. Both lubricants permitted bad scoring during the ten laps of the speed loop.

(E) – *Sulphur Saponifiable Lubricants.* – Seven lubricants of this type were tested. SAE Machine tests were made on five, all showing a decrease in load-carrying properties after heating. One dropped from 44 lb. at 750 r.p.m. before heating to 38 lb. after heating; one from 68 lb. at 750 r.p.m. to 52 lb.; one from 66 and 70 lb. at 750 r.p.m. (two tests) to 65 lb.; one from 85 and 230 lb. at 750 r.p.m. (two tests) to 80 lb.; and a fifth from 114 and 68 lb. at 750 r.p.m. to 38 lb.

Three of the lubricants prevented scoring during the ten laps of the speed loop but permitted bad scoring during the high-gear shock tests. The other four permitted scoring during the ten laps of the speed loop.

When inspections were made, particularly on those lubricants failing during the ten laps of the speed loop, appreciable quantities of small and fairly large steel chips adhering to the housing cover and in the lubricant were very noticeable.

(F) – *Chlorinated Lubricants.* – Thirteen lubricants of this type were tested. However, SAE Machine loads after heating were obtained on only seven of the lubricants.

One sustaining the full load at 750 r.p.m. before heating dropped to 340 lb. after heating and another dropped from 286 to 140 lb. Both lubricants permitted bad scoring during the ten laps of the speed loop.

One increased from 310 and 320 lb. at 750 r.p.m. before heating, to 330 lb. after heating and another from 80 and 200 lb. to 250 lb. Both lubricants permitted bad scoring during the ten laps of the speed loop.

One lubricant, sustaining loads at 750 r.p.m. of 350 lb., 370 lb. full load, full load (four tests) before heating, and full load after heating, permitted very noticeable "abrasive" action during the ten laps of the speed loop and bad scoring during the high-gear shock test.

One lubricant sustained loads at 750 r.p.m. of 328, 66, and 142 lb. before heating and 130 lb. after heating; another, 176 and 62 lb. at 750 r.p.m. before heating and 120 lb. after heating. Both permitted bad scoring during the two warm-up laps of the speed loop – (one lap at 60 m.p.h. and one at 70 m.p.h.).

SAE Machine results on the six lubricants not tested after heating varied widely – ranging from as low as 40 lb. up to the full load of the machine (at 750 r.p.m.).

Particularly noticeable were the large quantities of small and fairly large steel chips in these lubricants and adhering to the housing cover when the inspections were made. This condition appeared to be worse with this type of lubricant than with the sulphur saponifiable lubricants.

(G) – *Chlorine Sulphur Lubricants.* – Two lubricants of this type were tested. One containing 1.10 per cent sulphur and 0.85 per cent chlorine (lead-nil) sustained SAE Machine loads at 750 r.p.m. of 62, 74 and 574 lb. before heating and 70 lb. after heating.

The second lubricant analyzed 0.64 per cent sulphur and 0.95 per cent chlorine (lead-nil). SAE Machine loads at 750 r.p.m. of 312 and 100 lb. were obtained before heating, and 300 lb. after heating (also sustained 375 lb. at 500 r.p.m. after heating).

The first lubricant prevented scoring during the ten laps of the speed loop but permitted bad scoring during the high-gear shock tests. The second lubricant permitted very bad scoring during the ten laps of the speed loop.

(H) – *Sulphurized Lubricants.* – Five sulphurized oils were tested. One containing 1.65 per cent sulphur (chlorine and lead nil), sustained SAE Machine loads at 750 r.p.m. of 264 lb, 340 lb. and the full load (three tests) before heating, and 270 lb. after heating.

The second lubricant contained 1.75 per cent sulphur and 0.57 per cent chlorine (lead nil), and sustained the full load of the SAE Machine at 750 r.p.m. before and after heating.

The third lubricant containing 1.45 per cent sulphur and 2.97 per cent chlorine (lead nil) sustained loads at 750 r.p.m. of 460 lb., full load, and full load (three tests) before heating, and dropped to 370 lb. after heating (also showed 440 lb. after heating at 500 r.p.m.). (Should be classified as chlorine-sulphur.)

The fourth lubricant containing 1.81 per cent sulphur and 0.27 per cent chlorine (lead nil) sustained the full load at 750 r.p.m. before and after heating.

The fifth lubricant contained 5.64 per cent sulphur (chlorine and lead nil). It sustained loads at 750 r.p.m. of 264 lb., 290 lb., full load, full load, and full load (five tests) before heating and the full load on all tests after heating.

The five lubricants passed the proving-ground scoring test. The first four have not been approved or rejected as it is desired to test them further to determine if they may be corrosive to the steel parts of the axle.

The fifth lubricant is not a commercial possibility and had certain obvious faults – viscosity of 212 sec. at 210 deg. fahr., and was extremely thick at zero.

(I) – *Lubricants Containing Insoluble Zinc-Oxide and Soluble Lead.* – One lubricant of this type containing:

Soluble lead (calculated as PbO) in solution	3.13 per cent
Insoluble zinc-oxide (in suspension)	4.95 per cent

was tested. It sustained a load at 750 r.p.m. on the SAE Machine at 18 lb. before heating, no tests after heating being made.

This lubricant permitted very bad scoring during the two warm-up laps of the speed loop.

(J) – *Mineral Oil.* – One lubricant submitted by a manufacturer as an extreme-pressure hypoid lubricant was found to be a "straight" mineral oil when analyzed. It sustained a load at 750 r.p.m. of 8 lb. on the SAE Machine before heating and 10 lb. after heating (also sustained 65 lb. at 500 r.p.m. after heating).

The lubricant permitted very bad scoring while the car was being driven from the garage to the speed loop – less than one-half mile.

Viscosity

Saybolt Universal viscosities, reported by the laboratory, follow:

Viscosity at 210 Deg. Fahr., sec. Range	Number of Lubricants Reported
50-59	1 (special – for cold climates)
60-69	0
70-79	8
80-89	61
90-99	13
100-109	8
113	1
115	1
128	1
138	1
155	1
212	1 (special)

Chemical Analyses – Lead

The lead content of the lead soap-active sulphur lubricants passing the proving-ground scoring test, calculated as lead oxide (PbO), ranged from 0.81 per cent to 6.19 per cent:

Range of PbO, per cent	Number of Lubricants
Under 1.00	1 (1-0.81 per cent)
1.00-1.19	3 (1-1.06 per cent, 1-1.12 per cent, 1-1.19 per cent)
1.20-1.29	2 (2-1.20 per cent)
1.30-1.39	4 (1-1.37 per cent, 1-1.31 per cent, 2-1.39 per cent)
1.40-1.49	2 (2-1.44 per cent)
1.50-1.59	4 (3-1.51 per cent, 1-1.58 per cent)
1.60-1.69	1 (1-1.60 per cent)
1.70-1.79	2 (1-1.74 per cent, 1-1.78 per cent)
1.80-1.89	2 (1-1.86 per cent, 1-1.87 per cent)
1.90-1.99	1 (1-1.92 per cent)
2.00-2.09	4 (1-2.06 per cent, 1-2.09 per cent, 1-2.01 per cent, 1-2.02 per cent)
2.10-2.19	4 (1-2.16 per cent, 1-2.17 per cent, 1-2.18 per cent, 1-2.19 per cent)
2.20-2.29	3 (1-2.21 per cent, 2-2.27 per cent)
2.30-2.39	2 (1-2.30 per cent, 1-2.32 per cent)
2.40-2.49	1 (1-2.41 per cent)
2.50-2.59	3 (1-2.51 per cent, 2-2.55 per cent)
2.60-2.69	0
2.70-2.79	3 (1-2.74 per cent, 1-2.77 per cent, 1-2.77 per cent)
2.80-2.89	1 (1-2.88 per cent)
2.90-2.99	5 (2-2.90 per cent, 1-2.94 per cent, 1-2.95 per cent, 1-2.96 per cent)
3.00-3.09	2 (1-3.00 per cent, 1-3.07 per cent)
3.10-3.29	0
3.30-3.39	1 (1-3.33 per cent)
3.40-3.49	3 (3-3.44 per cent)
3.50-3.59	0
3.60-3.69	3 (1-3.64 per cent, 2-3.68 per cent)
3.70-3.99	1 (1-3.93 per cent)
4.00-5.00	1 (1-4.55 per cent)
5.00-6.00	2 (1-5.52 per cent, 1-5.90 per cent)
6.00-7.00	1 (1-6.19 per cent)

Fifteen lubricants containing lead soap, but not passing the proving-ground scoring test, showed lead oxide as follows:

Number	Lead, Calculated as Lead Oxide, per cent
1	0.62
1	0.69
1	0.96
1	1.06
1	1.36
1	1.41
1	1.43
1	1.69
1	1.81
1	1.88
1	2.09
1	2.64
1	2.87
1	3.65
1	3.91

Chemical Analyses – Sulphur

The total sulphur content of the lubricants varies widely. The laboratory has not completed sulphur determinations on all of the lubricants. Those reported to date follow:

Lead Soap-Active Sulphur Lubricants

Sulphur, per cent	Number of Lubricants
1 to 1.5	10
1.5 to 2.0	10
2.0 to 2.5	8
2.5 to 3.0	14
3.0 to 3.5	4
3.5 to 4.0	4
4.0 to 5.0	1
5.0 to 6.0	1

Lead Soap-Sulphur Saponifiable-Chlorine Lubricants

1.69	1
2.18	1
3.10	1

Mild Type Lead Soap-Sulphur Saponifiable-Chlorine Lubricants

0.60	1
2.59	1

Lead Soap Lubricants with No Sulphur, and Lead Soap Sulphur Saponifiable Lubricants, and Lead Soap Lubricants with Very Small Amounts of Active Sulphur

0-0.50	4
0.50-1.00	2
1.00-1.50	1
1.50-2.00	1
2.00-2.50	1
2.50-3.00	2
3.00-3.50	2

Sulphur Saponifiable Lubricants

0.33	1
0.96	1
1.20	1
1.48	1
1.82	1
1.88	1

Chlorinated Lubricants

0.18	1
0.27	1
0.40	1
0.42	1
0.55	1
1.32	1
2.28	1

Chlorine-Sulphur Lubricants

Sulphur, per cent	Number of Lubricants
0.64	1
1.10	1

Sulphurized Oil Lubricants

1.45	1
1.65	1
1.73	1
1.81	1
5.64	1

Chemical Analyses – Chlorine

Lead Soap-Sulphur Saponifiable-Chlorine Lubricants

Chlorine, per cent	Number of Lubricants
0.70	1
1.10	1
1.76	1

Mild-Type Lead Soap-Sulphur Saponifiable-Chlorine Lubricants

0.21	1
0.27	1

Chlorinated Lubricants

1.86	1
2.01	1
2.29	1
3.23	1
3.35	1
3.36	1
5.13	1
5.26	1

Chlorine-Sulphur Lubricants

0.85	1
0.95	1

Sulphurized Lubricants

Nil	2
0.27	1
0.57	1
2.97	1

Oxidation

(A) – Lead Soap-Active Sulphur Lubricants

Per Cent Increase in Viscosity	Number of Lubricants
Under 10	20
10-19	15
20-29	9
30-39	6
40-49	1
50-59	2
73	1
84	1
100	1
137	1
144	1
153	1

(B) – Lead Soap-Sulphur Saponifiable-Chlorine Lubricants

—18	1
—16	1
22	1

(C) – Mild Type Lead Soap-Sulphur Saponifiable-Chlorine

3	1
22	1

(D) – Lead Soap Lubricants with No Sulphur and Lead Soap-Sulphur Saponifiable Lubricants and Lead Soap Lubricants with Very Small Amounts of Active Sulphur

—2	1
0-9	7
20-29	2
30-39	1

(E) – Sulphur Saponifiable Lubricants

2	1
7	1
15	1
29	1

(F) – Chlorinated Lubricants

—22	1
0	1
6	1
8	1
9	1
15	1

(G) – Chlorine Sulphur Lubricants

—11	1
7	1

(H) – Sulphurized Lubricants

13	1
21	1
30	1
31	1
51	1

Evaporation

(A) – Lead Soap-Active Sulphur Lubricants

Per Cent Loss by Evaporation	Number of Lubricants
0- 4.9	47
5- 9.9	9
10-14.9	0
15-20	3

(B) – Lead Soap-Sulphur Saponifiable-Chlorine Lubricants

2.1	1
3.5	1
3.7	1

(C) – Mild Type Lead Soap-Sulphur Saponifiable-Chlorine Lubricants

0.5	1
3.2	1

(D) – Lead Soap Lubricants with No Sulphur, and Lead Soap-Sulphur Saponifiable Lubricants, and Lead Soap Lubricants with Very Small Amounts of Active Sulphur

All Under 4.0 per cent

(E) – Sulphur Saponifiable Lubricants

0	1
1.7	2
3.1	1

(F) – Chlorinated Lubricants

0.5	1
1.5	1
1.9	1
2.0	1
2.9	1
3.1	1

(G) – Chlorine-Sulphur Lubricants

1.8	1
2.3	1

(H) – Sulphurized Lubricants

0	1
2.3	1
2.6	1
5.0	1
8.0	1

Non-Combustible Sediment

(A) – Lead Soap-Active Sulphur

Per Cent of Non-Combustible Sediment	Number of Lubricants
Less than 0.01	15
0.01-0.019	12
0.02-0.029	8
0.03-0.039	5
0.04-0.049	2
0.05-0.059	2
0.06-0.069	0
0.07-0.079	1
0.08-0.089	0
0.09-0.099	1
0.10	3
0.11	1
0.12	1
0.16	2
0.24	1
0.31	1
0.50	1
0.53	1
0.73	1
1.24	1

(B) – Lead Soap-Sulphur Saponifiable-Chlorine Lubricants

0.002	1
0.06	1
0.07	1

(C) – Mild-Type Lead Soap-Sulphur Saponifiable Chlorine Lubricants

0.11	1
0.41	1

(D) – Lead Soap-Lubricants with No Sulphur, and Lead Soap-Sulphur Saponifiable Lubricants, and Lead Soap Lubricants with Very Small Amounts of Active Sulphur

Under 0.01	6
0.01-0.019	0
0.02-0.029	1
0.03-0.039	1
0.04-0.049	2
0.44	1
0.59	1
0.71	1

(E) – Sulphur Saponifiable Lubricants

Trace	1
0.001	2
0.002	1
0.004	1
0.008	1

(F) – Chlorinated Lubricants

Nil	3
0.002	2
0.024	1
0.03	1
0.041	1

(G) – Chlorine Sulphur Lubricants

Trace	1
0.002	1

(H) – Sulphurized Lubricants

Nil	2
0.001	1
0.002	1
0.007	1

Lubricant Temperatures Enroute to Texas

Rear-Axle Lubricant Temperatures. – The following temperatures were not stabilized at any constant speed but show the range obtained in actual traffic conditions between the cities.

Lead Soap-Active Sulphur Lubricant

From To	Miles	M.P.H.	Air Temperature, deg. fahr.	Axle Lubricant Temperature, deg. fahr.
Fort Wayne to Monticello	102	65-70	73-75	164-165
Hillsboro to Temple	65	65-70	64-66	162-172
Georgetown to Austin	43	65-70	72	154-168
Austin to San Antonio	77	70-80	72-73	170-184
Pleasanton to Premont	116	65-70	65	162-172
Kingsville to Corpus Christie	38	60	66	160
Kingsville to Corpus Christie	38	70	66	167
Kingsville to Corpus Christie	38	50	66	161
Gordon to Arkadelphia	—	60-70	82	174-178
Arkadelphia to Hot Springs	37	50-60	81	168-172

Transmission Lubricant Temperatures. – The following temperatures are not stabilized at any constant speed but show the range obtained in actual traffic conditions between the cities.

Lead Soap-Active Sulphur Lubricant

From To	Miles	M.P.H.	Air Temperature, deg. fahr.	Lubricant Temperature, deg. fahr.
Fort Wayne to Monticello	102	65-70	73-75	162
Hillsboro-Temple	65	65-70	64-66	158-164
Georgetown-Austin	43	65-70	72	155-165
Austin-San Antonio	77	70-80	72-73	167-170
Pleasanton-Premont	116	65-70	65	162-166
Kingsville-Corpus Christie	38	60	66	166
Kingsville-Corpus Christie	38	70	66	167
Kingsville-Corpus Christie	38	50	66	161
Gordon-Arkadelphia	—	60-70	82	171-173
Arkadelphia-Hot Springs	37	50-60	81	165-169

Evolution of Bus-Fleet Maintenance Practices

Floyd Patras
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BUS maintenance grew from haphazard patchwork repairs. Shortage of vehicles compelled stocking of service units. Standardization of equipment never has been accomplished. With competent mechanics not obtainable, they must be trained in bus work.

Card files and other records now keep track of performance of every unit and all major parts. Service expectancy cannot always be based on the past performance of the part. Complete inspection of all parts is periodically necessary.

Taxes make large numbers of standby buses economically impossible. High mileages are obtainable from modern buses. Rear engine locations are popular with the public.

Larger and better oil and air filters are needed; the same is true of oil coolers. Lubrication is not a problem. All worn parts now pass through the salvage department. Most units on modern coaches are of ample size and cause little trouble. Hypoids operate satisfactorily. Fuel economy is quite satisfactory considering weights and operating conditions.

SINCE the writer is not an engineer but just a mechanic, this discussion necessarily must be of a non-technical nature. I shall endeavor to cover what has been accomplished in bus-fleet maintenance and discuss present maintenance methods and problems. These subjects will be presented in the language of a mechanic and from the viewpoint of a mechanic.

Because of the fact that road and traffic conditions, weather and climatic conditions, operating speeds, the length of the haul, and the average number of stops per mile vary widely between different operations and in different parts of the country, it naturally follows that our experiences have been, in many cases, quite different from those of many other fleet maintenance men. As a matter of fact, we find that problems arising on our line from St. Louis, Mo., to Albuquerque, N. M., are usually quite different from those encountered on the Gulf Coast.

As the first bus operations began at about the time jitneys were popular, naturally the first buses were of the same general type as jitneys. As such cars were of a rather makeshift nature, it soon became apparent that something of more rugged construction was necessary.

It was only natural, therefore, that bus operators turned to the use of truck chassis on which were mounted such bodies as were obtainable. Since pleasure cars of that period had riding qualities about on a par with trucks, these buses proved quite satisfactory from a passenger viewpoint for several years.

Either the owners or hired drivers drove the vehicles and two or three maintenance men were expected to wash and grease the buses and to go out and make repairs on them on the road when they no longer would run at all. Preventive maintenance was, of course, unthought of.

Since the wagon builder or cabinet manufacturer who had constructed the body had no conception of vehicle maintenance, many unnecessary problems for the maintenance man were built into the bus. When a mechanic attempted repairs to one of such vehicles, he not infrequently found that the body manufacturer in constructing the body entirely on the chassis had enveloped completely the transmission, steering gear, or perhaps the motor itself to the extent that repairs or removal were impossible until portions of the body were cut away. Most mechanics knew very little about woodworking and, as a result, most of such body alterations were not very satisfactory. I might add that modern body manufacturers occasionally make some of the same errors in design by covering parts and units which must be removed frequently for repairs.

As bus lines grew and schedules were set up and serious efforts were made to maintain them, it became apparent that the practice of repairing a bus only after it failed could no longer be tolerated. Some kind of comprehensive maintenance system must be worked out.

Since no bus operation ever had a large number of "standby" vehicles, it was never possible to tie up any bus for several days for a complete overhaul. The most logical method seemed to be to purchase extra motors, transmissions, steering gears, and other major assemblies to be installed during the lay-over time, such change to be made at definite mileage periods. The removed assemblies were to be overhauled at will for reinstallation in some other vehicle.

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This method was extremely difficult at first because any fleet of ten buses probably consisted of five or six different makes or models, the units of which were not interchangeable. Several years elapsed before much was accomplished in the nature of standardized fleets. Because of yearly changes in models, complete standardization of equipment never yet has been realized. The elaborate service unit change and repair programs now in use by the major bus companies evolved directly from this early practice of changing assemblies.

As the riding qualities of pleasure cars were improved, passengers became more "ride-conscious," and it became necessary to provide better bodies on the buses. Because the bus industry had progressed more rapidly than the designing and manufacturing methods of the commercial body builders, many bus operators decided to build their own bodies.

The maintenance man now found himself called upon to be not only a mechanic and a "grease monkey" but also a body designer and manufacturer. Although this phase was largely over his head for a while, he soon met the challenge and turned out very creditable bodies considering the inadequate tools with which he had to work.

Shortly, body manufacturers saw the commercial possibilities in the bus field and began supplying satisfactory bodies to the operating companies. To the credit of the maintenance organizations, we find that many of the design and manufacturing innovations worked out in bus repair shops were adopted and are still used by body manufacturers.

The expansion of bus lines was retarded for several years because of the inability or unwillingness of manufacturers to recognize the needs of bus operations. On the best chassis obtainable, brakes were inadequate. Engines were of insufficient power, springs were short and inflexible, tire equipment was inadequate, steering gears were unsafe at high speeds, and chassis lubrication was required at too frequent intervals.

The bus industry only became a real factor in the mass-transportation field after the long-wheelbase, wide-tread, low-floor-height parlor coach appeared.

Since that time the motor coach has been a highly specialized type of vehicle quite different from other types of motor vehicles in many respects. As a result, perhaps the greatest difficulty of the man charged with the maintenance of a bus fleet has been and is that of obtaining and training competent repair men.

Many years elapsed from the time air brakes first were applied to motor coaches before the average repair man became familiar with them. Voltage and current regulators now appearing on automobiles are an old story on buses. Various other items about a bus are entirely "Greek" to the average mechanic seeking employment. It is impossible for a maintenance superintendent or a shop foreman to obtain men in an emergency who are skilled in bus maintenance. The best that the harassed shop foreman can hope to do is to select the most likely looking candidates and hope that he can make efficient bus mechanics out of them in from six months to a year.

For several years no comprehensive records other than cost records were kept. Since the buses were all on short runs and were each in the garage for some portion of each day, the mechanic's memory was considered sufficient with regard to the service of parts. A check mark and a coach number on a calendar served as a reminder when the next unit changes were due.

As runs were made longer and fleets grew larger, need arose for more complete records and information. The very complete coach unit records now kept make not only possible but commonplace the present-day coach round trips of 2000 to 4000 miles without service other than gasoline, water, oil, and cleaning enroute. These records also make possible present coach mileages in excess of 20,000 miles per month.

Now, when a new bus is received from the manufacturer, an identifying number is stamped on each unit and each major part. A card is made out for the files covering each numbered unit or part and notation made of the number, make and model, date in service, and so on. When any unit is removed for any reason whatever, a notation is made on the card showing date, garage, reason for removal, new parts used in overhauling it, and service miles rendered. Installation date is shown again when the unit is returned to service. Complete performance information is now available concerning not only every unit assembly but also nearly every part.

The buses of the company by whom I am employed are operated on the following schedules:

Bus Schedules

A group between Kansas City, Mo., and St. Louis, Mo., in local service – distance one way, 262 miles. Major maintenance is performed at St. Louis but, if the need arises, buses may receive some repairs at Kansas City.

A group between Kansas City, Mo., and Chicago, Ill. – distance one way, 517 miles. These buses receive minor repairs at Kansas City and Chicago, but are worked into St. Louis for major repairs.

A group between St. Louis, Mo., and Denver, Colo. – one way, 920 miles – laying over 7 hr., 15 min. in Denver and continuing to Amarillo, Tex., via Trinidad, Colo. – one-way distance, 458 miles. Total one-way distance from St. Louis is 1378 miles. The schedule does not permit the coach to go to the garage in Kansas City. There is a 20-min. stop only at Trinidad. Buses are fueled at Salina, Kan., and Trinidad.

A group between St. Louis, Mo., and Albuquerque, N. M., via Kansas City, Mo.; Salina, Kan.; Dodge City, Kan.; Trinidad, Colo.; and Las Vegas, N. M. – one-way distance, 1227 miles. No stops enroute exceed 30 min. Buses are fueled at Salina, Kan., and Trinidad. These buses then operate one to six schedules to Denver and return to Albuquerque before being turned back to St. Louis. Distance each way Denver to Albuquerque is 497 miles.

A group between St. Louis, Mo., and El Paso, Tex., via Springfield, Mo.; Tulsa, Okla.; Dallas, Tex.; and Abilene, Tex., one way, 1440 miles. Buses are fueled at Tulsa, Dallas, and Pecos, Tex. Schedules permit washing and cleaning at Tulsa and Dallas. There is sufficient time for only very minor repairs, however, at these points. Major maintenance is performed at St. Louis.

The first fifteen coaches placed on this division July 1, 1934, have accumulated in excess of 635,000 miles to date.

A group between Tulsa, Okla., and Amarillo, Tex., via Oklahoma City, Okla., one-way distance, 398 miles, no service or fueling enroute. Buses are maintenanced at Tulsa and worked into Fort Worth, Tex., for major repairs.

A group between Dallas, Tex., and Corpus Christi, Tex., via San Antonio, Tex., one way, 431 miles. There is no service or fueling enroute.

A group between Houston, Tex., and Laredo, Tex., via San Antonio, Tex., one way, 435 miles. There is no service or fueling enroute except a few scheduled to permit time for the coach to go to garage for fuel.

A group between Fort Worth, Tex., and Lake Charles, La., via Waco, Tex., and Houston, Tex., one way, 434 miles. There is no service enroute. Buses are fueled at Waco, Tex.

A group between Dallas, Tex., and Memphis, Tenn., one way, 532 miles. Buses are fueled at Pine Bluff, Ark. Some of these coaches cut off twice per month for local service between Stuttgart, Ark., and Little Rock, Ark. Units are maintenanced at Dallas, Tex.

SOUTHWESTERN GREYHOUND LINES, INC.
INSPECTION "A" FORM M-44

Garage No.......... Coach No.......... Mileage.......... Date..........

	MECH. NO.
* 1 Front End, springs, tie rod, drag link, steering & tie rod arms, spindles	
2 Check & adjust valves, valve rockers & shafts	
3 Clean carbureter, air filter, gas lines, fuel pumps & connections	
* 4 Check spark plugs, distributors, wiring & generator. Generator & regulator seals	
5 Clean purolator strainers	
* 6 Adjust fan belt & timing chain, check governor seals	
* 7 Check wheel studs & axle flange studs, air springs	
* 8 Check brakes, airlines & connections, horn air horn & windshield wiper	
* 9 Exhaust lines & connections	
*10 Check battery & cables, check & refill pyrene gun, test & check hydraulic jack	
*11 Check drive lines & flanges	
12 Seats, baggage racks, tarps, windows, doors, door operator, floor & first aid kit	
13 Panels, mouldings, bumpers, lights, roof, rear grille, tire carrier & passenger door steps	

REMARKS..........

COACH CANNOT BE O K'D UNTIL THE INSPECTION IS COMPLETED

Tester.......... Foreman..........

NOTE—On trips less than 1,000 miles, check only items marked (*) Trips over 1,000 miles, check all items.

Fig. 1

A few local runs of from 35 to 415 miles require from one to three buses each. Each such run presents its own maintenance problem which is treated individually.

Our garage locations are as follows: Fort Worth, Tex., and St. Louis, Mo., garages are equipped to take care of all classes of repairs and overhauls. Garages at Dallas, Tex.; Tulsa, Okla.; Houston, Tex.; and Kansas City, Mo., handle minor inspections and service work and can, in emergency, handle major repairs. Small shops for washing, fueling, and emergency repairs as well as storage are located as follows: Trinidad, Colo. – three men; Denver, Colo. – two men; Waco, Tex. – 1 man; Lake Charles, La. – 1 man; San Antonio, Tex. – 4 men; Pine Bluff, Ark. – 2 men; and Little Rock, Ark. – 1 man.

Arrangements have been made with other bus companies for services, storage and emergency repairs at Memphis, Tenn.; El Paso, Tex.; Albuquerque, N. M.; and Chicago, Ill.

Cards showing the installation date of all units and such other pertinent information as dates of piston-ring installation, when valves were ground last, cylinder oversize, and crankshaft and bearing undersize are carried in each bus at all times for the information of foremen of outlying service garages.

Although these card records supply a world of valuable information, we do not find them very valuable in enabling us to estimate the service life of a part. For instance, a part may

10,000 Mile Inspection

SOUTHWESTERN GREYHOUND LINES, INC.
INSPECTION "B"

FORM M-44

Mileage..........

Garage No.......... Coach No.......... Service Order No.......... Date..........

	MECH. No.	MECH. No.	MECH. No.
1. Carefully inspect the engine governor, properly set and seal it			
2. Check wheel bearings			
3. If hubs are removed, brakes should be thoroughly checked and hub grease retainers renewed, if necessary			
4. Inspect brake cam bushings and renew if necessary			
5. Inspect brake drums and renew if necessary			
6. Inspect brake linings and renew if necessary			
7. Inspect, deflate, and reprime air springs			
8. Remove and inspect disc wheels			
9. Lubricate all wheel studs and nuts with a mixture of finely powdered graphite and oil			
10. Check compression and grind valves if necessary			
11. Boil out and flush radiator and replace any defective hose connections or gaskets			
12. Check exhaust manifold gaskets and make sure exhaust manifold is in its proper place and not warped			
13. Check intake manifold gaskets in same manner			
14. Check carefully for leaks in the exhaust system, and repair			
15. Check air lines and connections and check the operation of all brake valves			
16. Check all bolts on all brake diaphragms and replace the diaphragm if it appears to be in any way defective			
17. Tighten all spring U-bolts			
18. Thoroughly inspect the interior of the body and correct all hazards to the clothing and personal safety of the passengers			
19. Carefully inspect the passenger door, making sure that the door operator, door hinge, door guide plates and window, and weather stripping, are all in good condition			
20. Tighten body hold-down bolts			
21. Check water pumps and replace packing if necessary			
(By "Replace" we mean replace with a repaired, or overhauled or new part.)			

REMARKS:

COACH CANNOT BE OK'D UNTIL THE INSPECTION IS COMPLETED

Tester.......... Foreman..........

Fig. 2

render an average of 300,000 miles of service after being delivered to us in a 1935 model coach; yet the same part of identical design but made of better material available in 1936 may render 500,000 miles of service.

Again the reverse condition may be true. We find a crankshaft operating consistently more than 600,000 miles in a 1934 coach, but the same shaft of the same design and material failing in a 1936 coach at less than 200,000 miles because of a change in engine installation.

Not being able to depend entirely on our records, we are compelled to maintain a rather elaborate inspection procedure in order to detect defects and fatigue fractures before failure actually occurs. One form, known as Inspection *A* shown in Fig. 1, is used covering a definite inspection procedure to be

20,000 Mile Inspection

SOUTHWESTERN GREYHOUND LINES, INC.
INSPECTION "C"

FORM M-44

Mileage..........

Garage No.......... Coach No.......... Service Order No.......... Date..........

	MECH. No.	MECH. No.	MECH. No.
1. Remove oil, inspect pan, and check nuts on connecting rod and main bearing bolts, being sure that all cotter pins are in place			
2. Check oil lines and connections and make any adjustments that are necessary			
3. Thoroughly clean oil screen and oil pan before replacing			
4. Check and adjust clutch			
5. Thoroughly clean all front axle steering connections, and check same closely for cracks			
6. Clean, inspect, and adjust steering gear			
7. Carefully check timing chain and both valve timing and ignition timing			
8. Inspect all electrical units and change those which do not appear to be in sufficiently good operating condition to go through the next 20,000 mile inspection period			
9. Check differential unit as closely as possible without removing same			
10. On axles which are equipped with removable covers, cover should be removed so that the parts may be more closely inspected. Change the units if not in good condition			
11. Inspect drive line and drive line carriers			
12. Carefully check fuel connections and valves between the fuel pump and tank			
13. Inspect all springs and replace any that are broken or that are too low			
14. Replace piston rings if poor oil mileage and lack of compression indicate a change should be made, replacing with Perfect Circle type 70 compression rings, and Perfect Circle type 85 oil regulating rings			
15. Replace all spark plugs with new ones, or good reconditioned ones			
16. Voltage regulator to be carefully inspected, properly adjusted, and sealed			
17. Inspect all seats and cushions, repairing or replacing any which show cuts or rips in the covering material			
18. Inspect all seat back reclining ratchets, and repair or replace any not in good condition			
19. See that all foot rests are in place			
20. Inspect and repair if necessary, all aisle seats			
21. Thoroughly clean the interior of the bus, giving particular attention to the front, including the headboard and the dash			
22. Remove and clean, or replace drapes, if necessary			
(By "Replace" we mean replace with a repaired, or overhauled or new part.)			

REMARKS:

COACH CANNOT BE OK'D UNTIL THE INSPECTION IS COMPLETED

Tester.......... Foreman..........

Fig. 3

followed at the completion of each trip. One is for use at the completion of 10,000 miles (Inspection *B*, Fig. 2), and another for use upon completion of 20,000 miles (Inspection *C*, Fig. 3). Two forms, one for the chassis (general) and the other for the body, shown in Fig. 4, outline the procedure in inspecting and overhauling each coach at the completion of each 60,000 miles. The coach is taken to one of our major shops for the latter inspection. It is, of course, not feasible to maintain more than one or two well-equipped major shops in an operation such as ours. It is also impossible to license each coach in all of the states in which we operate. For these reasons, the minor inspections are taken care of by the service garages, and only the 60,000-mile inspection is handled by the major shops. When necessary, units are shipped to the service shops from the major ones. At the 60,000-mile period, every unit is removed and disassembled and every part is cleaned thoroughly. The salvage foreman then inspects each part and either returns it to service, scraps it, or sets it aside for a salvage repair operation.

Even though the 60,000-mile inspection is very elaborate and complete, we find that the use of service units enables us usually to return a coach to the road in 72 hr. or less from the time it reaches the inspection crew. Due to a perennial shortage of coaches, it is imperative that the tie-up time be as short as possible.

The equipment-shortage problem has always been the bane

of the maintenance man's existence. Early-day operators were not financially able to purchase surplus coach equipment. Nowadays, we have the problem of taxes. When we consider the fact that license taxes, street taxes, ton and mile taxes, seat taxes, utility-commission taxes, personal-property taxes, excise taxes, and other taxes directly applicable to the coach itself and exclusive of fuel taxes, frequently approach and occasionally exceed 40 per cent of the original purchase price of each bus on a transcontinental operation, it becomes quite obvious that no operator can afford to keep many spare pieces of equipment.

When truck chassis were used, it was not necessary to carry a large parts inventory. The bus operator simply went to the local truck dealer's parts department and obtained what he needed. Now, of course, the dealer does not carry sufficient parts for a fleet of from 100 to 250 buses so the operator must carry his own stock of material. Naturally, the building up of a parts inventory of from $100,000 to $130,000 has necessitated the setting up of a very complete stock accounting system. This stores accounting set-up is really much more complex than that of a dealer or distributor because the shop not only purchases material from the stores department but also sells material to stores in the form of overhauled units and reconditioned used parts.

As previously mentioned, removed parts no longer all land in the scrap box, but instead a very earnest effort is made to return every such part eventually to useful service. The salvage foreman's job is, of course, a difficult one, calling for rare judgment. No rule-of-thumb method has been devised that will tell us where to draw the line between parts which should be scrapped and those which can be salvaged. Therefore, each part must be considered individually. It is, of course, very easy to expend more money in the repair of a part than can be justified by the miles that can be obtained from it. Again, it is equally easy to scrap a part which could be repaired economically were more thought and time given to it. Some parts cannot be repaired economically, and it is also economically sound practice to spend more than the cost of a new part on certain other parts because of the greater number of miles which can be obtained from them than from new parts.

Cracked or broken transmission cases, crankcases, axle housings, and similar parts are repaired by welding. Worn brake camshafts and similar parts are turned down, built up by welding with Tobin bronze or mild steel, then machined to original size. Frequently bearing cups become loose in hubs. The hubs are turned out ¼ to 5/16 in. in diameter over original bore, and a steel sleeve turned from Shelby tubing is pressed into the hole. After the sleeve has been turned and ground to size, the repaired hub will render better service than a new one. Cylinder-heads and cylinder-blocks are not repaired by us but are sent out to welding shops specializing in such work. Crankshafts are re-ground to a maximum of 0.060 in. undersize and then scrapped. To avoid confusion, all crankpins on a shaft are ground to the same undersize and the same thing is true of main-bearing journals, regardless of the condition of the shaft when it is removed from the engine. Broken disc wheels and rims are repaired by arc welding.

Many Accessories Added

Many accessories such as air filters, oil filters, and oil coolers have been added to our bus engines as the old-type buses have evolved into the modern palatial motor coach. But most of these accessories are still accessories hung onto the dash, or what have you, like the tar bucket on the plainsman's covered wagon, instead of being designed as an integral part of the engine as we repair men believe that they should be designed.

Our buses are stored in warm garages so that we need not be concerned about the failure of oils to flow at low temperatures. Our crankcase temperatures rarely exceed 215 deg. fahr. so the tendency of oils to break down at high temperatures is not one of our problems. Nevertheless, we believe that an efficient and satisfactory oil temperature-regulating device is necessary. We have tried a few different makes of coolers and have not found them satisfactory. These coolers

60,000 Mile Inspection

SOUTHWESTERN GREYHOUND LINES INC

GENERAL INSPECTION **FORM M-44**

Mileage..........

Garage No.......... Coach No.......... Service Order No.......... Date..........

	MECH. No.	MECH. No.	MECH. No.
1. Remove, clean, and adjust or replace front axle assembly. Thoroughly inspect all parts of the front axle and steering connections, making very sure that no cracks or flaws exist. At this time, hubs, spindles, or spindle arms should be removed and replaced if even the smallest of hairline cracks is found			
2. Remove and repair or replace steering gear			
3. Remove and overhaul or replace transmission and clutch			
4. Remove and overhaul or replace entire propellor shaft			
5. Remove and overhaul or replace differential units			
6. Thoroughly clean axle shafts and check for cracks			
7. Remove and replace brake application valves and O-I governor			
8. Replace carburetor			
9. Remove air compressor head and replace and thoroughly inspect compressor and replace if necessary			
10. Remove all electrical units, test and repair or replace			
11. Remove engine cylinder heads and grind valves			
12. Remove and inspect pistons and replace rings			
13. Inspect connecting rod bearings and replace if necessary			
14. Inspect main bearings and replace motor if bearings are found in bad condition			
15. Thoroughly clean all crank shaft oil leads			
16. Remove and clean all oil lines			
17. Remove oil pump, inspect and replace if necessary			
18. Dismantle and thoroughly clean and adjust oil relief valve			
19. After cleaning oil relief valve, wash all dirt out of complete oiling system with clean light oil			
20. Reface valve tappets			
21. Remove fan, check all blades for cracks. Replace complete fan if cracks are found			
22. Check frame and outriggers for loose rivets and cracks			
23. Replace or recondition all brake chambers			
24. Remove and replace all air brake hose, making sure that no frame brackets or pipes can possibly interfere with brake diaphragms or brake hose			
25. See that air lines and gasoline lines are securely fastened to frame and to cross members			
26. Rebush or replace frame spring brackets			
27. Remove and repair or replace water pump			
28. Replace timing chain and inspect timing gears and replace if necessary			
29. Replace all spark plug and coil wires			
(By "Replace" we mean replace with a repaired, or overhauled or new part.)			

REMARKS:

COACH CANNOT BE OK'D UNTIL THE INSPECTION IS COMPLETED

Tester.......... Foreman..........

60,000 Mile Inspection

SOUTHWESTERN GREYHOUND LINES INC.

BODY INSPECTION **FORM M-44**

Mileage..........

Garage No.......... Coach No.......... Service Order No.......... Date..........

	MECH. No.	MECH. No.	MECH. No.
1. Repaint roof			
2. Remove and replace any damaged panels			
3. Inspect entire body as closely as possible and replace any damaged or rotted wood			
4. Carefully check floor covering and repair any portion that is worn through and remove any stumbling hazards			
5. Thoroughly clean all seats and make any repairs necessary to the covering material			
6. Tighten all seats thoroughly to remove rattles			
7. Attach all cushions so that they can be easily removed but so that they can not fall or be thrown from the seat			
8. Any seats found to have badly worn leather are to be refinished with black, brown, or green lacquer which can be obtained from the stock-room			
9. Baggage racks are to be thoroughly inspected and cleaned. Any loose bolts or screws are to be replaced. Make sure that baggage racks are securely attached to their brackets and that two rubber shock cords are provided			
10. See that all windows are in good condition and sufficiently tightened in the run ways to prevent rattles. Make sure, however, that windows operate as freely as possible			
11. Make sure that driver's windshield is not scratched or blurred in any way that will restrict the driver's vision of the road			
12. Thoroughly polish ceilings and underside of baggage rack and other paint work on the interior of the bus with a non-grease type of polish			
13. Replace all head-light and spot-light reflectors with replated ones. Headlights, doors, spotlights, and other plated hardware in which the plating is in bad condition are to be chrome plated			
14. All new panels are to be painted and all old scratches at all points where the paint is shabby, either on the inside or outside are to be touched up			
15. The exterior of the body, hood, and fenders are to be thoroughly polished			
16. Make sure that destination sign is in working order and that correct destinations are lettered on the roll for the run to which the bus is allocated			
17. Make sure that tire carriers are in good condition and replace any tire carriers that do not securely hold the spare wheel in place			
18. Check fuse box, junction box, starter switch, dimmer switch, and all exposed wire connections			
19. Replace any wires where old wires are in bad condition			
(By "Replace" we mean replace with a repaired, or overhauled or new part.)			

REMARKS:

COACH CANNOT BE OK'D UNTIL THE INSPECTION IS COMPLETED

Tester.......... Foreman..........

Fig. 4

all have had one thing in common, namely, that the major part of the cooler is a small section of radiator core. The small passages of the core soon become clogged by sludge, causing the cooler to become inoperative. These passages are very difficult to clean, and it is not possible to be sure that all parts of the core ever are cleaned entirely. These fragile cores frequently burst, resulting usually in most of the oil being forced into the cooling system. We believe that an efficient, rugged, and easy-to-clean oil cooler can be designed and built into the engine.

Most oil filters that we have tried have been quite efficient whether of the felt-packed, waste-packed, or metallic-element type. Those of sufficient capacity must be attached to the dash or to some part of the engine and connected to the lubricating system by means of tubing. The breaking of oil-gage tubes alone, whether they be of the plain copper or the flexible variety, is a source of considerable trouble. Every pipe that is added is just one more place for failure to occur. The units attached directly to the crankcase are so small that they are almost always clogged and inoperative before the completion of round trips of 2000 miles or more. They are also almost invariably in such an inaccessible location that cleaning is difficult. We are constantly reminded that, when a coach load of passengers departs, for instance from St. Louis, Mo., bound for El Paso, Tex., 1440 miles away, those passengers want to reach their destinations as quickly and with as little inconvenience as possible. Schedules are fast, lunch and rest-period stops are short. It is, therefore, not feasible to attempt to service oil filters enroute. Surely an efficient oil filter can be built into the lower portion of the crankcase where it can be cleaned easily and quickly.

Oil Filters Satisfactory

Most of the oil-bath types of air filters have proved to be quite satisfactory, even in extreme conditions encountered in the so called "dust bowl." A great deal of trouble was experienced in 1935 due to dust abrasion until tests of air filters could be completed. The cost of engine parts alone which were replaced as a result of dust damage exceeded $9000 over a three-month period. Since that time, practically no damage has been experienced. Efficient air filters on the carburetor inlet, oil-fill pipe, crankcase breather, and air-compressor inlet have solved the problem completely.

The use of very hard cylinder sleeves has prolonged greatly the service life of blocks between regrinds. Blocks with hard sleeves are removed rarely from engines located in front at less than 120,000 miles. Crankshafts, however, should be harder than the sleeves. In certain engines, rapid sleeve wear does occur. When the oil filter becomes clogged, these hard particles circulate through the oiling system and become imbedded in the bearings. Rapid shaft wear naturally results.

I have very little comment to make concerning modern motor oils. Most oils are good. Modern heavy-duty coach engines have ample bearing area and are easy to lubricate. We use S.A.E. 30 and S.A.E. 40 oils with average mileages including drains of from 100 to 140 miles per qt.

Transmission gears and bearings are of generous size and present no real lubrication problems. No extreme-pressure lubricants are used, the same grade of mineral cylinder oil being used for both transmissions and final drive gears.

Several sets of rear-axle gears have rendered in excess of 600,000 miles of service and are still running. Nineteen coaches are operated which are equipped with hypoids. Several gear failures have occurred as a result of pinion-bearing failures. No failures have been experienced which could be laid to faulty lubrication. Some of these hypoids are still in service after having operated more than 200,000 miles.

The older types of universal joints rarely rendered more than 30,000 miles of service before replacement of journals and bushings became necessary. The needle-bearing-type joints operate 150,000 to 200,000 miles before repairs are necessary. Very little wear actually occurs in the needle bearings. Eventually the journal becomes slightly "brinelled." Occasionally the needle-bearing sleeves become loose in the yokes. This trouble is apparently because of manufacturing machining tolerances being too great. When new oversize sleeves are ream-fitted to the yokes, no further difficulty of this nature occurs. Needle bearings require only about 7 per cent as much lubricant as older-type joints.

Air brakes, when properly inspected at reasonable intervals, render almost trouble-free service. A small metal alcohol bottle is attached by means of a tee to the inlet of the air compressor. Alcohol fumes are introduced into the incoming air in sufficient quantity to prevent freezing of the air lines and valves in low temperatures.

Gas Analyzers Employed

In an endeavor to obtain satisfactory fuel mileage, both the Hays Orset and the "Power Prover" type of gas analyzers are used. The newer coaches of approximately 24,000 lb. gross weight used on long runs are showing from 5.0 miles to 5.5 miles per gal. The average for the entire fleet of 149 buses of various makes and models is 4.87 miles per gal. An air-fuel ratio of 12.5:1 is maintained as nearly as possible. Road, operating, and traffic conditions, of course, cause individual coach performances to vary widely.

A particular model of 33-passenger bus, when operating between Pine Bluff, Ark. and Texarkana where stops must be made for picking up and discharging passengers at almost every cross-road and farmhouse, does very well to show an average of 3.5 miles per gal. When the same bus is placed on a transcontinental schedule where stops are infrequent, 5.2 miles per gal. may be obtained.

Manually operated carburetor chokes have never been satisfactory. Even when heavy springs are provided to open the choke valve, drivers will bend the pull rod or find some other means to hold the choke partly closed during the warm-up period. Then they frequently forget to open the choke after the engine is warm with wasted fuel, and damaged engines result. The automatic choke devices are of flimsy construction for bus service. Even when new, they frequently become inoperative before completing a 3000- or 4000-mile round trip. A much more satisfactory device is a pushbutton-operated solenoid which closes the choke valve tight while the button is pressed and does not operate at any other time. The driver has no means of partly choking his engine at any time.

The new-model coaches having the engine installed in the rear have proved extremely popular with the traveling public. Since the powerplant necessarily is very compact, making many parts extremely inaccessible, they are not so popular with the mechanics charged with making repairs. This condition is particularly true when, as very frequently happens, the coach must be sent out on another schedule within an hour or two of its arrival at the garage. A large number of repair operations must be performed while the engine is still hot.

There is some dissension among various departments as to just what constitutes a road failure. To the traffic department, any mechanical difficulty which delays a schedule is a road failure. However, our company operated just over 18,000,000 bus-miles in 1936; 153 failures occurred requiring the substitution of another bus or the services of a mechanic, either a company employee or from a nearby public garage.

Cab-Over-Engine Trucks—Their Status and Advance in Design

By Austin M. Wolf
Consulting Engineer

DEPENDING upon the location of the front wheel, the door and step are placed either at the front or back of the cab. Some designs incorporate a protruding "hood" portion, whereas others extend the cab fully forward. The engine compartment is either immediately back of the radiator or under the cross seat. The floor and seat heights are relatively higher than in the conventional truck, and better visibility is obtained. The engine hood is well insulated for heat and sometimes for sound as well. Most powerplants are removable readily for major repairs although, in most instances, major maintenance operations can be done readily within the cab.

Front axle treads have been increased in order to give greater stability on the road as well as to avoid an excessively large wheelhouse.

The change in weight distribution has called for considerably more study on braking distribution. The shortened wheelbase requires a more accurate location of the fifth wheel in tractor-semi-trailer service; has emphasized the importance of the steering-angle conditions of the front axle; and has brought riding qualities to the fore.

Specifications and dimensional data accompany the paper, as well as drawings of typical layouts showing the cab, engine, and front-axle relationships.

MANY will recall that, during the early days of the gasoline truck, the driver was disposed above the engine compartment at the front of the vehicle, placing him in a considerably elevated position and without the luxuries of the modern enclosed cab. Among others, the names, Mack, Alco, Alden-Sampson, and Pope Hartford come to mind. The name, Autocar, is almost synonymous with "cab-over-engine," although its original "engine-under-seat" is more descriptive of the pre-cab era.

For many years, English bus designers extended the right side of the body forward and placed the driver alongside the engine, leaving the left-front half of the conventional hood design. In making the left side symmetrical with the right, the Metropolitan type resulted, and it is interesting to note that the C.O.E. truck and bus designs of several manufacturers have the same front-end ensemble, with similar forward shape and curvature of the cab and bus body. There is no doubt about a similarity of requirements in both instances. Although the entrance and egress of passengers present an entirely different problem, it will, nevertheless, be noted that the location of the door in front of or behind the front wheels still shows quite a diversity of opinion in both fields.

Cab Construction

In the case of the truck, the forward location of the door with its hinge at the back and the step at the front, gives greater access for getting in or out as there is no body interference. In this case, the front axle is located toward the rear of the cab. When the axle is located toward the front, the door is hinged forward and the mounting step located at the rear of the fender, as in Fig. 1, showing the White 809 C.O.E. model. This layout lends itself toward making the door self-closing and it seemingly facilitates the driver's rear view, making it possible for him to hold the door ajar while looking back around the corner of the body. This point of visibility is also tied up with the cab width, which runs as high as 78 to 80 in. (See Table 1). The length of the door window and its relative position with the driver is also a factor in this matter of rear visibility. It is interesting to note that Mack changed a year ago from its original front hinged door to one that hinges on its rear edge, as indicated in Fig. 2. In view of the current use of both door locations, there is probably a more basic underlying reason for the arrangement selected, and in which the door is really a matter of secondary importance. This reason concerns the front axle location, which will be discussed later.

Front-End Types

Most of the C.O.E. trucks started with a protruding "hood" portion, and this design is used by Federal, General Motors (see Fig. 3), Studebaker, and Ward LaFrance. This front-end design might be designated Type *A*. The "hood" portion permits a more forward fender location without detracting from the appearance. When Autocar introduced its modern streamlined type, there was a slight protuberance ahead of the cab proper, housing the radiator. This intermediate type is used also by Sterling and F.W.D., and we might classify it as Type *B*.

The modern smooth-exterior all-encompassing cab (Type *C*), used by Autocar, International Harvester, Mack, Reo, and

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White, provides a line effect that is in keeping with the universal trend in all fields of design toward clean, smooth exteriors. The accomplishment of hiding the many chassis details such as shackles, springs, frame, brackets, and so on, imparts an esthetic touch, from which even a truck, in most of its applications, should not be immune. However, we must be practical and "keep our feet on the ground" in not permitting the artist to sacrifice accessibility and vision for mere appearance.

Engine Compartment

In all cases the radiator is located near the front face of the cab or the protruding "hood" portion. On the smooth-type cabs a flush grille covers the radiator opening and is detachable readily to give access to the radiator core and the almost universal removable powerplant. Fig. 4 shows the Mack C series. The engine compartment is located immediately back of the radiator in all trucks except in the case of Autocar (Fig. 5) and International Harvester (Fig. 6), where it is located under the cross seat. The latter construction permits the use of a continuous seat frame and a clear front compartment except for the top radiator connection between the cylinder-head and the radiator. With the engine forward, the center portion of the seat would serve no purpose and, furthermore, this space is required to clear part or all of the engine hood.

Floor, Seats, and Windshield

Since the cab is located over the engine, the floor and seat (see Table 2) are relatively higher than in the conventional truck where usually the transmission alone is located below the floorboards, and the bell-housing and clutch compartment are conveniently housed below the toeboard. The higher location of the driver and the elimination of the conventional long hood result in better visibility. The inherent good visibility possibilities have, however, been nullified in some designs of the *C* type by the cut-off due to the relatively high location of the bottom of the windshield. The same height on an *A* and *C* type would work out to the detriment of the latter, assuming an equal overall from the radiator grille to the rear of the cab and the same seat location at the back of the cab. A V-type windshield works to good advantage especially when the bottom side corners are lower than the center.

Since the visibility is allied so closely with safety, it is suggested that "visibility data" be obtained by some disinterested source in which the results might be presented at some future meeting. With a standard location of the operator's eyes relative to the seat cushion and back, diagrams would be compiled showing the actual visible distance on the ground (assuming a flat surface) ahead of the vehicle for different right and left angular inclinations of sight. These tests might well include the cut-off due to the front corner posts and also, by placing the vehicle a given distance back of a vertical wall, the cut-off due to the top of the windshield and without the driver crouching down from the normal position.

Special Cabs

The sleeper-cab and the five- or six-man cab fit in very well with the C.O.E. truck since the additional length required does not encroach on the body length which would be used on a comparative conventional truck. Naturally, the 3 ft. or so that are gained permit the use of a longer body than in the case of the conventional truck without added overall length or increased wheelbase. Fig. 7 shows an Autocar sleeper-cab with a 92 in. outside length. The Sterling sleeper-cab measures 87 in. long, 80 in. wide and 61½ in. high (outside dimensions). International Harvester has a six-man cab with outside length, width, and height of 100 13/16 x 60 x 72 in. respectively and corresponding inside dimensions of 88 5/16 x 54½ x 52 in. Fig. 8 shows an F.W.D. six-man cab. There is, naturally, a limit to the shortest body that can be placed properly on a C.O.E. chassis since the wheelbase would become undesirably short. Thus, Reo does not use the C.O.E. chassis for bodies of 9 ft. 0 in. length or less.

Engine Hood Insulation

Insulation of the cab from the engine compartment on the score of heat and fumes has been well carried out in view of

Table 1 – Cab and Tread Data

Make	Front-End-Type	Cab Width (outside), in.	Front-Axle Tread, in.	Rear-Axle Tread (duals), in.	Bumper to Front-Axle, in.	Front-Axle to Back of Cab, in.	Top of Cab to Top Frame Rail, in.	Projection Behind Cab	Location Center of Gravity of Engine Ahead or Back of Front-Axle, in.
Autocar	C	64	69½–74	68½–71⅞	52¾	24¾	63	None	12¾ Back.
Federal	A	70½	69½–71½	62–69¾	29 1/32	44⅜	70½	None	
F. W. D.	B	84	70¾	71	59	23½	61½	None	9⅝ Ahead.
General Motors	A	64 11/16	60⅞–70½	65–71¾	35 3/16–36½	44	65 7/16	None	15 Back.
International Harvester	C	60	61–62 3/16	63–63¼	54 15/16	15½	60	Transmission housing, fenders.	¾ Ahead.
Mack, E Series	C	70	67½	67½–68	49½	24	64	Slight amount for shift lever.	8 15/16 Ahead.
Mack, C Series	C	78	78–80¾	69⅞–70	49½	24	64	None	8 43/64 Ahead.
Reo	C	59½	64–65⅝	65⅛	36½	44½	65¼	None	¾ Back.
Sterling	B	80	70¼	70	41⅜	31	61½	Part of Transmission.	4½–6¾ Back.†
Studebaker	A	63	67⅝–69⅝	63–69¾	34 7/16	41⅜	62 25/32	None	6 Back.
White, 805 Series	C	68½	73½–78⅞	67⅞–70⅝	36¾	37	60¾–61¾	Slight amount for gear-shift lever.	7 Back.
White, 730, 1	C	78 3/16–81	80⅝	72 9/16	45½	23½	62 9/16–63 9/16	None	0
Ward LaFrance	A	74	74	70–72½	51	24	68	None	6–8 Back.
Montpelier	C	80	64*		26⅞	47		None	
Dearborn	A	Ford	Ford	Ford	26	49.3	65	None	

† Former with Waukesha 6D100; latter with Cummins 6HB.
* On Chevrolet Replacement.

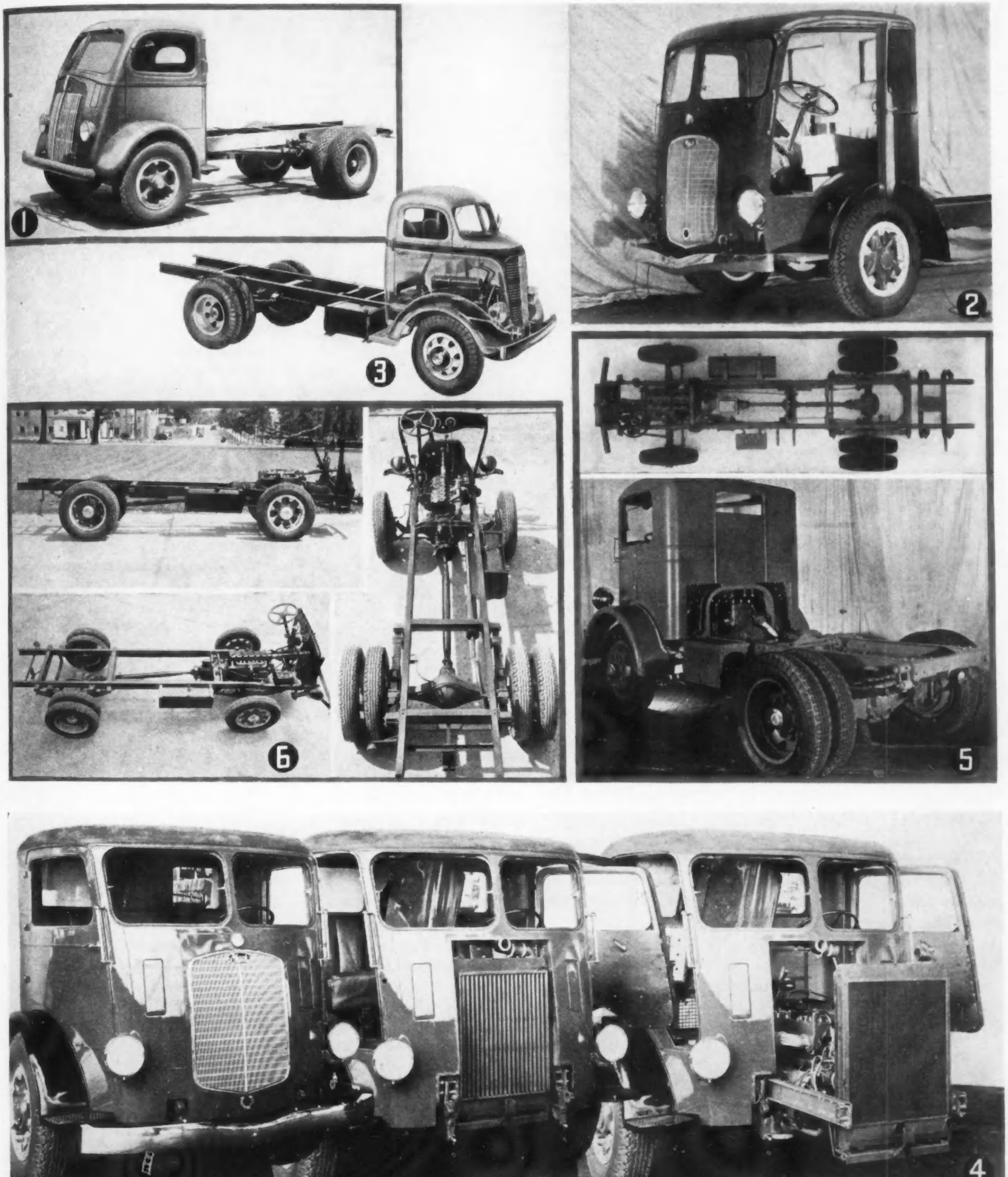


Fig. 1 – White Model 809 with Door Hinged Forward and Step at Rear of Fender

Fig. 2 – Mack Model EC with Door Hinged at Rear and Step Ahead of Fender

Fig. 3 – General Motors Design with Protruding Hood Effect

Fig. 4 – Mack C Series Showing Progressive Steps in Removing Powerplant

Fig. 5 – Autocar with Engine Under Seat

Fig. 6 – International Harvester C.O.E. Truck with Engine Under the Seat and Offset 15 Deg. from the Vertical

Table 2 – Models and Seat Data

Make	First Model Produced	No. of Models	Models	Height of Cab Floor Above Side Rail, in.	Height of Cab Floor Above Ground Full Load, in.	Height of Cushion Above Floor, in.	Depth of Seat Including Back, in.	One-or Two-Piece Cushion	Widths (Two-Piece) Right and Left
Autocar	1909	14	"U" Series	6¼	37 (9.75-20 tires)	19	22	2	26–26
Federal	1936	4	75, 80, 85, 89	6½				2	
General Motors	1934	11	F-16 to F-61H	12½	40½ (7.50-20), F-16 47½ (40x10), F-61H	14¾	25½	2	Bucket Seats
International Harvester	1936	1	D-300	5¼	31⅜ (30x5)	16³⁄₁₆	24	1	
Mack E Series	1906	2	EB, EC	7½	39⁵⁄₁₆ (8.25-20)	18½	18¼*	2	15½–18
Mack C Series		2	CH, CJ	6	41 (9.75-22)	18½	18¼*	2	17–17
Reo	1935	3	2D4M GB80	10⅞	38¼ (1936 data)			2	
Sterling	1933	5	GD70, 90, 97, 115	11		14	22½	2	Bucket Seats
Studebaker	1936	4	J15 (20, 25, 30)M	10	35–37	13½	23	2	23–24
White	1934	7	805 9, 10, 12, 18 730; 1	7⅝–8 ⅝	35¾ (7.00-20), 805 40½ (9.75-20), 818	12½ driver 14½ passenger	22⅝	2	33–18
Ward La France	1934	2	K, L	8 at rear° 14 at front		12ˣ	26	2	21–21

* Not including Seat Back. ° Frame tapered on top. ˣ To bottom of cushion.

previous experience on bus design. As a rule, the insulating material is sandwiched between the hood proper and the inner liner. The insulation naturally suppresses sound to some extent and, in the White models, the inner shell is perforated (Burgess Acousti-Plate) for more efficient noise absorption. The various types of insulating material used will be noted in Table 3. A number of manufacturers provide a clear opening at the back of the engine compartment and cab or place a grille or louvred panel over it. Dependence is not placed on it for ventilation as often an integral body and cab requires its elimination. Autocar's vertical tunnel from the fan back to the engine compartment insures ventilation of the underseat space as well as to house-in the top water connection. The rear of the cab is usually flush, although in a few instances a slight projection exists to shield a direct-mounted gear-shifting lever. The International Harvester transmission projects 3 5/16 in. above the frame and 17 in. back of the cab but this projection is of no consequence in view of the customary body stringer height. (See Table 1 regarding such projections.)

Control and Powerplant

The gear-shift control is often of the direct type, the lever being fulcrumed in the transmission cover and extending forward at an angle. This construction is used by General Motors; Mack, E Series; Reo; Studebaker; White 805 Series and up; and Ward LaFrance. Where the resultant up and down movement of the shift ball is not desired or when the distance to the transmission is too great, a remote control is used. There is a limit to how far one can ask a driver to reach around behind his back to shift gears. The remote control is sponsored by Autocar; International Harvester; Mack, C Series; Sterling; and White 730 Series. Direct mounting of the hand brake is used by General Motors; Mack, C Series; Reo; White, 805 Series and up; and Ward LaFrance. Remote control (mounting the lever differently from the conventional truck design) is incorporated by Autocar; International Harvester; Mack, E Series; Sterling; Studebaker; and White, 730 Series. The Mack E Series hand brake is shown in Fig. 9 and the C Series shift in Fig. 10. Reo, by moving the engine further forward, has changed the shift control from remote to direct in its new models.

Most designs provide for a removable powerplant which can be slid forward in the manner of the old Grabowsky truck after removing the radiator grille and front enclosure plate. The powerplant, including the radiator in most cases, is mounted on a removable sub-frame. Major repairs can then be made on it although, in most instances, the customary servicing can be done without removal. What is necessary to remove the powerplant and what operations can be performed without its removal are listed in Table 4. A variety of removal procedures is presented and warrants comparison and study.

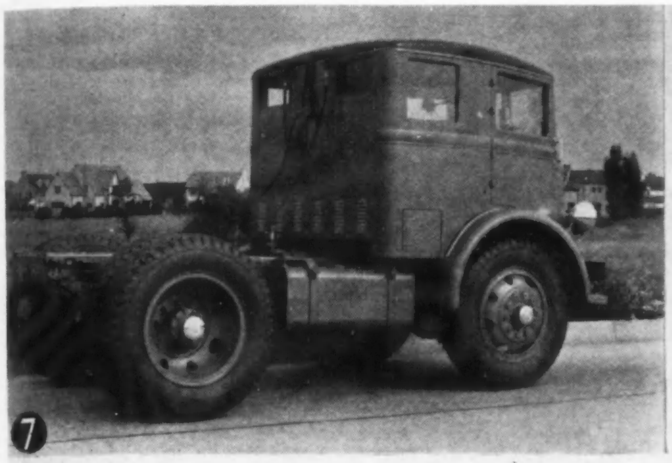
Table 3 – Engine Compartment and Hood Insulation

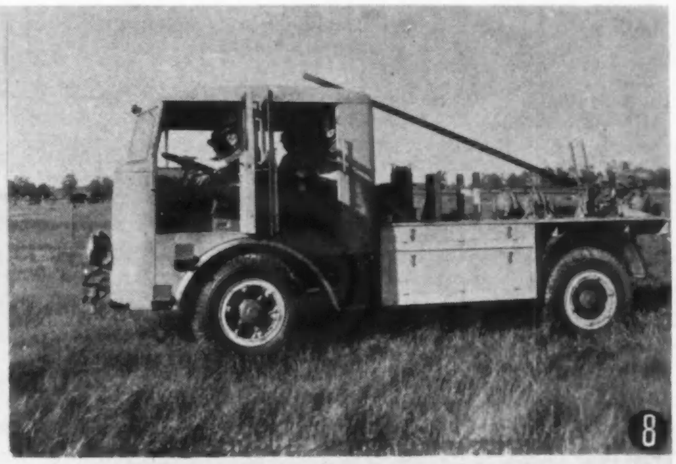
Make	Size of Engine Compartment or Housing	Type of Heat Insulation
Autocar	Under Seat.	Sea-Pak.
General Motors	Smallest: 11¾ in. wide, 5⅝ in. High Front, 3¾ in Rear (F-16) Largest: 18½ in. wide. 10 in. High Front, 7 in. Rear (F-18 to F-61H)	Asbestos insulating material.
International Harvester	Under Seat.	Insulated coverings.
Mack, E Series	42 x 18 x 18 in.	Cellular asbestos between double walls
Mack, C Series	46¾ x 24 x 13¹⁵⁄₁₆ in.	Cellular asbestos between double walls.
Reo		Asbestos between double walls.
Sterling	56⅜ x 31 x 24 in.	½-in. thick Johns-Manville asbestos.
Studebaker	Irregular in shape.	Asbestos and aluminum foil.
White		Animal hair felt with fire-proof coating.
Ward LaFrance	26 x 34 x 18 in.	Ventilated sheet-metal hood, asbestos insulated.

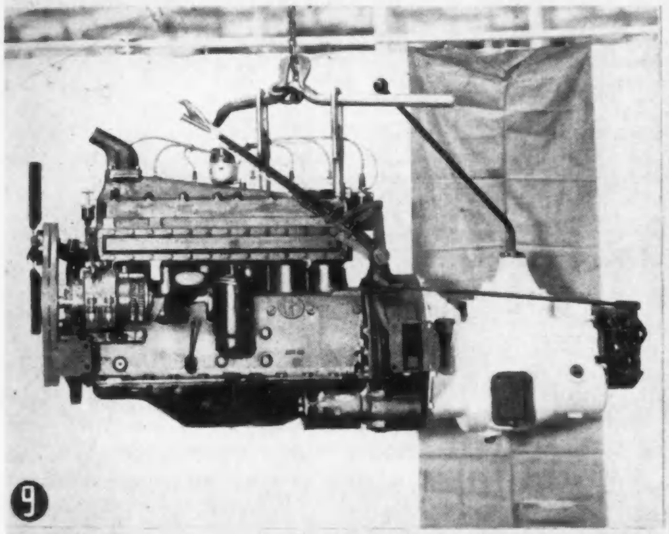
Thought should also be given to various service operations which could also be tabulated beneficially. Only one phase, that of engine oil filling, is given in Table 5.

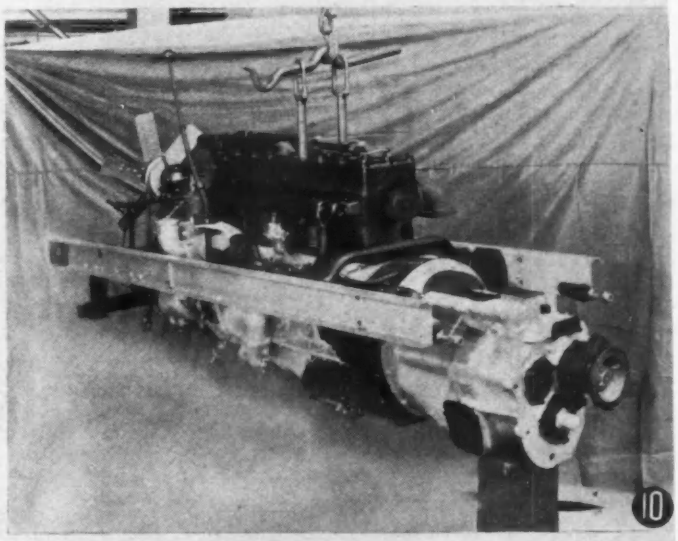
Sterling

In the case of the Sterling truck shown in Fig. 11, the cab is mounted so that it can be tilted forward in its entirety, exposing the powerplant completely. The engine may operate with the cab so tipped since no fuel or electrical connections are broken. A recent Sterling GD 70 with Truxmore third axle and Heil tank is shown in Fig. 12. This unit, slightly over 22 ft. overall length, was developed cooperatively by Sterling and the Shell Petroleum Corp. The chassis with tanks weighs approximately 15,000 lb. and, with a load of 1965 gal., the gross is 27,050 lb. The cab can be tilted in less than 30 sec. and returned to place in 15 sec. A locking lever is released









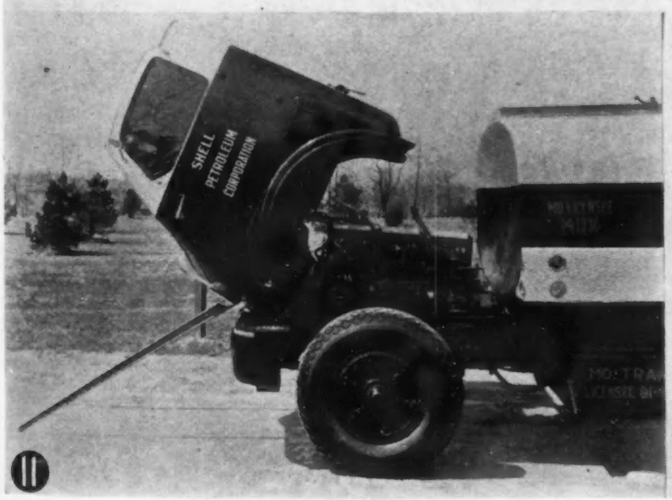


Fig. 7 – Autocar Tractor Chassis with Sleeper Cab

Fig. 8 – F.W.D. Truck with Six-Man Cab for Utility Company Use – Men Ride Safely Instead of Former Custom within Body

Fig. 9 – Mack Model EB Powerplant with Hand Brake Mounted on Bell Housing

Fig. 10 – Mack Model CH Powerplant with Remote Gear-Shift Control

Fig. 11 – Sterling Truck with Tilting Cab for Engine Accessibility

Fig. 12 – Sterling Tank Truck Showing Compactness Attainable with C.O.E. Design

Table 4 – Service Operations and Powerplant Removal

Make	Operations Without Removal	Operations Requiring Removal	How is Power Plant Removable?
Autocar	All major maintenance operations.	Reboring only.	Lift front end of chassis, remove front axle by removing spring pins, lower engine.
General Motors	All major and minor operations; valve grinding and adjusting, removal of cylinder-head, pistons, connecting-rods, camshaft, clutch and transmission.		Remove from front after removing engine hood, floor boards, toe-board, radiator shell, and radiator.
International Harvester	Practically all.		Remove seat, seat-box cover, floor and toe-boards, disconnect engine and remove through opening in rear of cab.
Mack	Practically all.	Reboring, replacement of main bearings.	By removing grille and access panel engine scuttle, and hood. E Series: Engine may be lifted and pulled through front with a floor crane. C Series: Remove mounting bolts and roll out the front.
Reo	Practically all.	Reboring, crankshaft and camshaft replacement, complete overhaul.	Through front.
Sterling	Tilting cab forward gives complete access to engine.	Cylinder-block or crankshaft replacement.	Remove 2 bolts front support, box cap; also engine shield bolts, rear support bolts and universal joint.
Studebaker	Valve grinding and adjusting, remove cylinder-head, pistons, connecting-rods, water pump and fan, clutch replacement and adjusting.	Cylinder-block, crankshaft or camshaft replacement.	Remove radiator grille and radiator core.
White	Practically all.	General overhauling on vertical engine models and crankshaft replacement on twelve-cylinder horizontal engine models.	Remove radiator grille and slide powerplant forward.
Ward LaFrance	All major repairs and adjustments.	Cylinder-block and other major replacements.	Sliding track.

at the rear of the cab, the steering column uncoupled by moving a slip sleeve, and tilting is done by inserting two levers in pockets above the front hinges. Floor boards, fenders, brackets, and so on, are not removed, and it will be noted that the gear shift and brake levers are curved about the hinge center.

The White 730

The White 730 Series with the twelve-cylinder horizontal engine provides an interesting construction. The cab floor and seat heights are no greater than in the usual C.O.E. designs, and the powerplant lends itself to vertical compactness as shown in Fig. 13. The dropped frame front-end is novel.

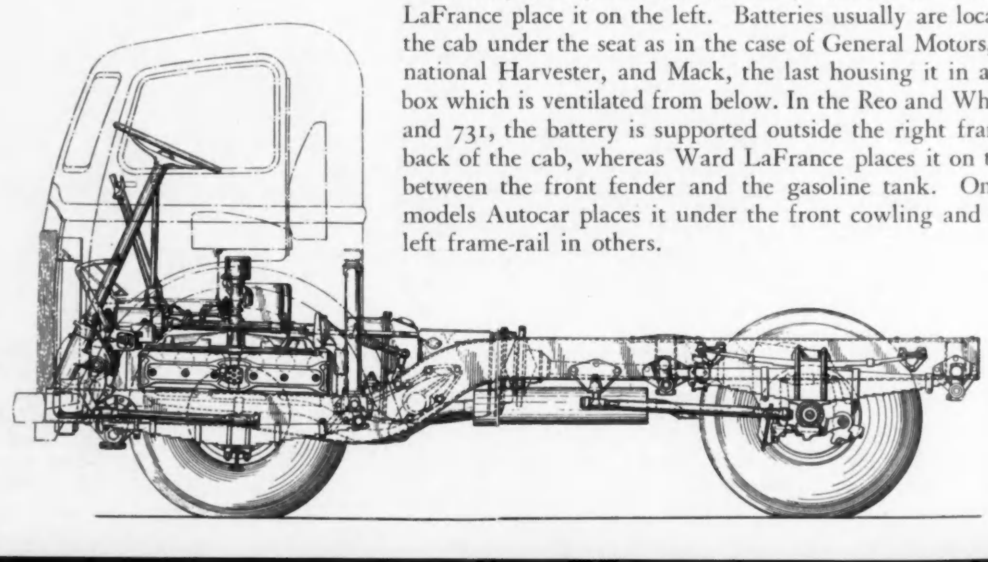


Fig. 13 – White Model 730 with "Pancake" Engine

Inclined Engines

In order to provide more room for the driver, particularly at the floor, and for greater accessibility of the powerplant, G.M.C. inclines the engine at 18 deg. from the vertical, as Fig. 14 indicates. The relatively low height of the hood is of interest in view of the use of an overhead-valve engine. International Harvester Co. inclines the engine 15 deg. for easier access in its under-the-seat position.

Gasoline Tank and Battery

The gasoline tank is mounted on the right frame-rail behind the cab by Autocar, Federal, General Motors, International Harvester, Mack, and White. Reo, Studebaker and Ward LaFrance place it on the left. Batteries usually are located in the cab under the seat as in the case of General Motors, International Harvester, and Mack, the last housing it in a metal box which is ventilated from below. In the Reo and White 730 and 731, the battery is supported outside the right frame-rail back of the cab, whereas Ward LaFrance places it on the left between the front fender and the gasoline tank. On some models Autocar places it under the front cowling and on the left frame-rail in others.

Axles

In view of throwing a greater component of the body and load static weights on the front axle, it would be possible theoretically to use a lighter rear axle. However, the slight difference over the loading of the conventional corresponding model is not sufficiently great to warrant the use of a special unit, and the interchangeability of parts on conventional and C.O.E. models further warrants the continuance of the same rear axle, as practiced by all manufacturers. Increased loadings naturally require a different front axle from that used in the corresponding conventional model. Table 6 gives some examples. Steering gears have kept pace with the heavier axle equipment and, from the point of view of ease of steering, refinements in axles and steering gears have made power-steering unnecessary.

A surprising point is the decreased weight of the International and Studebaker models as the universal trend is toward increased weight in the C.O.E. models over the conventional. Front-axle treads and the accompanying widened spring centers have increased the stability on the road. This design also makes it possible to get rid of an excessively large wheelhouse, especially where the axle is located forward of the driver and step. Table 1 indicates present front tread practice, and the use of around 80 in. will be noted.

Propeller Shaft

In tractor units every possible bit of length is conserved in the driving mechanism to get proper propeller-shaft angles and adequate length. This problem of length sometimes comes up in winch installations where the split-propeller-shaft power take-off is used. The matter of installing control levers for the winch and its power take-off in the cab is difficult due to the high cab mounting and the engine occupying so much needed space. Special control sets have been developed. The first winch installations required a special power take-off which was much thinner than the conventional in order to clear spring hangers and shackles. This arrangement is no longer needed with later chassis design changes, especially with the increased spread of the front springs accompanying wider track front axles.

Critical Factors

The shortened wheelbase and the approach of the center of gravity of the load toward the front axle have brought about a rather abrupt change in dynamic weight distribution, making conditions more critical than in the case of conventional design which is less sensitive to weight transfer, thus adding to the braking problem. Not only is greater weight transferred forward, but the same amount is subtracted from the rear.

Table 5 – Oil Level Indicator and Filler

Make	What Must Be Done to See Oil Level?	What Must Be Done to Add Oil?
Autocar	Oil gage (electric) on instrument panel.	Remove driver's seat; lift engine cover.
General Motors	Push aside handhole cover in floor board to reach bayonet stick.	Push aside handhole cover.
International Harvester	Oil gage (electric) on instrument panel.	Remove seat and seat-box cover.
Mack	Trap door in floor gives access to bayonet stick.	Trap door in floor gives access to filler.
Reo	Oil gage (electric) on instrument panel.	Small trap door in top of hood; oil filler extended alongside radiator filler.
Sterling	Raise engine housing in cab.	Raise engine housing in cab.
Studebaker	Remove plate in floor.	Remove plate in floor.
White	Open small door in engine hood.	Open small door in engine hood.
Ward LaFrance	Through door in engine hood.	Through door in engine hood.

Table 6 – Comparative C.O.E. and Conventional Chassis Weights and Front-Axle Ratings

Make	Additional Chassis Weights (lb.) of Similar Gross Weight Models: Gross	C. O. E. Additional	Comparative Front-Axle Ratings, lb.: Gross	C. O. E.	Conventional
Autocar*	25,000 26,500 28,000 29,500 36,000	820 600 760 440 410	25,000 26,500 28,000 29,500 36,000	7,500 10,000 10,000 10,000 10,000	7,500 7,500 7,500 or 10,000 10,000 10,000
International Harvester		70 less		3,800 4,330†	2,500 2,975†
Mack, E Series		700			
Mack, C Series		1,050			
Reo		100			
Sterling		None	Next heavier size over conventional.		
Studebaker		100–200 less	10–30 per cent greater; percentage increasing with wheelbase.		
White		200–300°		5,000 (805) 5,400 (809) 6,500 (810) 6,500 (812) 7,500 (818) 10,500 (731)	4,600 4,600 6,000 6,000 6,500 9,500
Ward La France		800, approximate			

* Based on largest tires listed; maximum given.
° Depending on wheelbase.
† Maximum load on ground.

Table 7 – Front-Rear Weight Distribution (Per Cent)

Make	C. O. E. Gross Ideal	C. O. E. Gross Estimated	C. O. E. Body and Payload Estimated	Conventional Gross Ideal	Conventional Gross Estimated	Conventional Body and Payload Estimated
Autocar	33.3–66.7	....	13–87 17–83	28–72	....	9–91 13–87
Mack [a]	33.3–66.7	30–70 41–59	16–84	30–70	25–75 34–66	13–87 16–84
Reo	32–68	30–70 33–67	18–82 [d] 20–80 [d]	21–79 [b] 24–76 [c]	20–80 26–74	3–97 [d] 8–92 [d]
Sterling	33.3–66.7		12–88 [e] 14–86 [e] 15–85 18–82		25–75 28–72	10–90 12–88
Studebaker [f]	25–75	21–79	2.5–97.5		19.5–80.5	2.2–97.8
1½- and 2-Ton		28.7–71.3	9.6–90.4		24–76	5.5–94.5
Ward LaFrance	33.3–66.7		22–78	24–76		12.5–87.5
White	33.3–66.7		23.7–76.3	28.5–71.5		14–86

[a] Actual instead of estimated; based on all tires sizes.
[b] Short wheelbase.
[c] Long wheelbase.
[d] Does not include cab.
[e] If Diesel-powered.
[f] Actual instead of estimated, based on same tire for respective models.

The shortened wheelbase has called for an accurate location of the fifth wheel in tractor-semi-trailer service. The fifth wheel must be mounted very close to the tractor rear axle center so the forces coming from the trailer have a minimum effect on the steering conditions of the tractor. There is sometimes a temptation (when the installation is not made directly under the truck manufacturer's surveillance) to locate the fifth wheel too far forward to save on overall length. Steering geometry has assumed a greater importance since the accuracy of the steering angles of the front wheels must be held much more closely as the wheelbase decreases.

Six-Wheelers

A number of manufacturers furnish their C.O.E. models as six-wheelers. Autocar, Mack (on the C.J.), Sterling, White and Ward LaFrance comprise this group. General Motors and Reo are able to furnish on special order, whereas International Harvester; Mack, E Series and the C H; and Studebaker build only four-wheelers. The bogie unit inherently attempts to push the vehicle forward in a straight line and combats to some extent the steering effort of the front wheels. It has been shown that at least 14 per cent of the gross weight must be on the front axle to obtain safe steering response under adverse conditions.[1] We are assured of this amount, but the shortened wheelbase of the C.O.E. six-wheeler augments the problem due to the shorter lever arm that extends between the center of the bogie unit and the front axle.

Riding Qualities

Poor riding qualities often have been brought up against the C.O.E. design. Its impairment has been particularly noticeable on the extra short wheelbase as in the case of a tractor unit. The ability to obtain good riding qualities in a truck in which the load may vary continually and/or range from full load to no load has always been a real problem. This problem has been emphasized in the C.O.E. field and can be alleviated only by refined suspension design. Since the relative weight range is so much greater than in the case of a passenger car, and since the riding qualities are largely a matter of weight distribution and the resulting mass inertia, some form of multi-stage front spring appears as a possible solution. The relative position of the center of gravity of the engine from the front axle center shows quite a divergence, as disclosed in Table 1.

The relative location of the center of load and body in relation to the wheelbase is regulated by the distance from the front axle center to the back of the cab, and this table shows wide differences in this regard. Those manufacturers placing the front axle toward the front of the cab claim better riding qualities due to the larger wheelbase and with the driver behind the axle instead of directly over it. Of course wheelbase is but one of the many factors entering into this entire problem. The wider front treads have compensated for the larger wheelbases when the axle has been shifted forward by permitting a greater steering angle and at least the same turning radius as with the previous shorter-wheelbase design.

In view of the fine instrumentation developed by the Riding Comfort Research Committee, the C.O.E. design opens up a new field of investigation. Quite some time ago the Mack Co. developed a seismograph of its own design which probably was a pioneer effort aimed at riding comfort in the truck field. However, the developments in instruments since that period

Table 8 – Per Cent Gross Weight Distribution With Different Tire Sizes (Same Wheelbase and Cab-to-Axle Dimensions)

Tire Size	Model	Chassis	Body and Load	Gross Vehicle Weight
7.50–20	EC (C. O. E.)	66–34	16–84	41–59
	EM (Conventional)	52–48	13–87	34–66
8.25–20	EC (C. O. E.)	65–35	16–84	37–63
	EM (Conventional)	51–49	13–87	31–69*
	EB (C. O. E.)	58–42	16–84	36–64
	EQ (Conventional)	51–49	13–87	31–69*
9.00–20	EC (C. O. E.)	65–35	16–84	34–66*
	EM (Conventional)	51–49	13–87	28–72
	EB (C. O. E.)	58–42	16–84	33–67*
	EQ (Conventional)	51–49	13–87	28–72
	CH (C. O. E.)	63–37	16–84	39–61
	BM (Conventional)	56–44	15–85	33–67
9.75–20	EB (C. O. E.)	58–42	16–84	30–70
	EQ (Conventional)	51–49	13–87	28–72
	CH (C. O. E.)	59–41	16–84	34–66*
	BM (Conventional)	55–45	15–85	31–69*
9.75–22	CH (C. O. E.)	59–41	16–84	33–67*
	BM (Conventional)	55–45	15–85	29–71*
	CJ (C. O. E.)	58–42	16–84	33–67*
	BX (Conventional)	53–47	16–84	31–69*
10.50–20	CH (C. O. E.)	59–41	16–84	32–68
	BM (Conventional)	55–45	15–85	28–72
10.50–22	CJ (C. O. E.)	57–43	16–84	30–70
	BX (Conventional)	52–48	16–84	29–71*
10.50–24	CJ (C. O. E.)	57–43	16–84	30–70
	BX (Conventional)	52–48	16–84	29–71*

[1] See S.A.E. TRANSACTIONS, September, 1936, pp. 362-380: "The Construction and Operation of Six-Wheel Trucks," by Austin M. Wolf.

would warrant their present use for truck investigation and particularly in this field, since driver comfort spells the ability to do more and better work and the elimination of accident hazards due to fatigue. Certain perishable commodities are sensitive to their treatment in transit; consequently good riding qualities will insure revenue from this exclusive field.

Weight Distribution

The ideal static weight distribution on C.O.E. trucks is naturally 33 1/3 per cent front and 66 2/3 per cent rear. Practically all concerned are agreed on this point, and the body and payload component of the gross has been indicated to me by some manufacturers as shown in Table 7. It is interesting to note that the previous unanimity of weight distribution does

Table 9 – Per Cent Gross Weight Distribution With Different Tire Sizes (In Order of Tire Size Increase)

Tire Size	Chassis Weight		Body and Load		Gross Vehicle Weight	
	EC	EM	EC	EM	EC	EM
7.50–20	66–34	52–48	16–84	13–87	41–59	34–66
8.25–20	65–35	51–49	16–84	13–87	37–63	31–69
9.00–20	65–35	51–49	16–84	13–87	34–66	28–72
9.75–20		50–50		13–87		26–74
	EB	EQ	EB	EQ	EB	EQ
8.25–20	58–42	51–49	16–84	13–87	36–64	31–69
9.00–20	58–42	51–49	16–84	13–87	33–67	28–72
9.75–20	58–42	50–50	16–84	13–87	30–70	25–75
	CH	BM	CH	BM	CH	BM
9.00–20	63–37	56–44	16–84	15–85	39–61	33–67
9.75–20	59–41	55–45	16–84	15–85	34–66	31–69
9.75–22	59–41	55–45	16–84	15–85	33–67	29–71
10.50–20	59–41	55–45	16–84	15–85	32–68	28–72
	CJ	BX	CJ	BX	CJ	BX
9.75–22	58–42	53–47	16–84	16–84	33–67	31–69
10.50–22	57–43	52–48	16–84	16–84	30–70	29–71
10.50–24	57–43	52–48	16–84	16–84	30–70	29–71

not hold in the conventional truck by these same makers but shows a variation, though very slight.

It is desirable, when making a study of weight distribution, to compare the various models with all their optional tire sizes and to use actual figures as distinct from any theoretical or "advertised" set-up. I am indebted to the Mack International Motor Truck Corp. for the data given in Table 8 based on actual weights. It will be observed that there is an appreciable variation from the ideal distribution of 33 1/3 per cent and 66 2/3 per cent for the C.O.E., and 30 per cent-70 per cent for the corresponding conventional model. The gross weight distribution approximates the ideal in practically but one tire size for each model, which is noted by the asterisk in the table. It is obvious that it would be impossible, using the same wheelbases and the cab-to-axle dimensions with different tire sizes, to have the gross-vehicle-weight distribution remain constant. This condition is apparent when it is considered that the only distribution which remains uniform regardless of loading is body and load distribution, the chassis weight distribution varying according to the weight of the tire equipment.

Table 9 shows the preceding information in a different form bringing out the progressive decrease in the proportion of front chassis weight as the tire size increases. Conversely the gross vehicle weight on the rear tires increases with the tire size. With these variations it is seen that the under-tired chassis is always front-heavy, and the over-tired chassis, rear-heavy.

I am indebted to the Studebaker Corp. for the data shown in Table 10 covering its 1½- and 2-ton models, both conventional and C.O.E. A 25-75 per cent average is aimed at for the C.O.E. weight distribution, and the table shows the influence of varia-

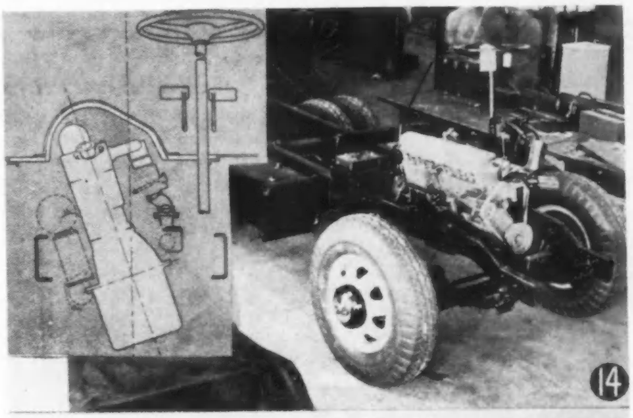


Fig. 14 – General Motors Chassis with Engine Inclined 18 Deg. from the Vertical

Fig. 15 – Montpelier Conversion of Conventional Chassis to C.O.E.

Fig. 16 – Dearborn Conversion of Ford Truck – Regular Cab is Moved Ahead

tions in wheelbase. Similar variations in the corresponding conventional models also are given.

Conversions

Interesting cabs with the steering gear and pedals moved forward have been developed which are applicable to various standard light trucks such as Ford, Chevrolet, Dodge, International Harvester, and so on. The Montpelier shown in Fig. 15, a *C*-type front-end, extends the body sides down to the running-board line. On the 131½-in. wheelbase chassis, the C. A. dimension is approximately 84 in., permitting the use of a 12-ft. body. On a 157-in. wheelbase the C. A. dimension of 110 in. permits the use of a 15-ft. body. The sill and under structure is largely of steel construction, and the cab structure is secured to it. Because of the rearrangement in the load distribution

Table 10 – Front-Rear Weight Distribution in Studebaker Models

Model		Per Cent Gross Weight		Per Cent Body and Load	
Type	Symbol	Front	Rear	Front	Rear
1½-Ton	J15M–101 W. B.	22.8	77.2	2.5	97.5
C. O. E.*	138	26.5	73.5	7.0	93.0
	162	28.7	71.3	9.6	90.4
1½-Ton	J15–138 W. B.	21.0	79.0	2.2	97.8
Conventional*	162	24.0	76.0	5.5	94.5
2-Ton	J20M–101 W. B.	21.0	79.0	2.5	97.5
C. O. E.†	138	25.0	75.0	7.0	93.0
	162	27.0	73.0	9.7	90.3
2-Ton	J20–138 W. B.	19.5	80.5	2.2	97.8
Conventional†	162	22.0	78.0	5.5	94.5
	180	22.0	78.0	5.0	95.0

* 11,500 lb. Gross Rating.
† 14,000 lb. Gross Rating.

over the original, new front axles, springs, and steering gears of greater capacity replace the standard.

The Dearborn conversion unit shown in Fig. 16, with *A*-type front, utilizes a standard chassis and the original cab is moved forward and supported on a separate steel sub-frame. A short hood finishes off the front end. It is tilted easily forward giving access to the radiator, battery, air-cleaner, fan belt, and water pump. The engine hood within the cab makes it possible to reach readily the carburetor, fuel pump and generator. The relative position of all controls (pedals, accelerator, steering gear, and dash controls) remain as in the original vehicle. A remote-control gear-shift control is supplied. With a C. A. dimension of 82.2 in. for the 131½-in. wheelbase chassis, a 16-ft. body is recommended by Transportation Engineers and with 107.7 in. C. A. dimension on the 157-in. wheelbase, it approves the use of a 16-ft. body. For tractor use, the 131½-in. wheelbase chassis is used and the rear axle is moved ahead 19½ in.

Conclusion

The C.O.E. truck is fitted ideally to many applications. There is no doubt that its appeal when first introduced, together with the enthusiasm it aroused, brought about some misapplications and unsound practices. These practices already have been recognized clearly. As in any new endeavor, it is natural that such "growing pains" should have been experienced during the early evolutionary stages. All recognize that the C.O.E. design is one of the many essential forms of truck needed to fill the requirements of present-day transportation which has now grown so large that it is best served by specialization for particular operations. It seems fitting, in closing this paper to pay tribute to a worthy and distinct pioneer in this field – The Autocar Co.

One Year's Lubrication Experience with Hypoids

HYPOID-GEAR design is not at all new although many outside the industry seem not to know this. Voluminous and thoroughly reliable lubrication data have been accumulated during the past dozen years. Long since has this design passed its period of infancy, attended by the standard diseases – gas pains, cholera infantum, and the cutting of new teeth of just the right geometry. The hypoid design has arrived at well-advanced middle age; hair grayed at the temples and slightly bald. In its face are character lines, there as a result of many campaigns, intensive discussions, and many differences of opinion. Its employment in the low-price, large-volume brackets of motor car manufacture is new, however, and introduces some important lubrication aspects.

How much trouble has been encountered in lubricating hypoids? Have there been many failures? The answer is simple – virtually none at all where approved hypoid lubricants have been used. One large motor-car company makes a practice of numbering their troubles according to volume. Axle trouble previously fell within the first ten complaints. Since its adoption of hypoid equipment, axle difficulties have sunk below the necessity for observation. In other words, the batting average of this design as a source of trouble is at present very low.

The program of manufacture and original factory lubrication of this equipment was carried out with ultra care and accuracy, hence the good results. It is fair to say that the motor companies fully realized the dangers of such a radical change in equipment and lubrication practice, and acted with corresponding care. Epidemics of trouble frequently result from carelessness or complacency. Neither was present in this program. Secondly, the oil industry did an honorable-mention job in the celerity with which they attained world distribution of suitable lubricants for this axle.

It is almost literally true that, in the fall of '36 there were no hypoid lubricants universally available to the public. By the early summer of '37 there were approximately 200 approved brands on the market in the United States. The material also was in adequate distribution throughout the entire civilized world, with the exception of Russia. The writer sincerely feels that both industries may rightfully congratulate themselves on the efficient completion of their joint program up to date. May we all relax now, content with our work, and go fishing? The writer believes not. There are danger factors for the future which should be studied carefully.

The public are not gear-lubricant conscious. This statement is in reality only too true. It is inevitably so through economic necessity. There is sufficient volume of business in motor oil, gasoline, tooth powder, soap, electric refrigeration, and halitosis, to promote public consciousness. No one has ever succeeded in promoting a national brand of darning needles. Gear lubricants in point of volume are the darning needles of the oil industry. Here lies a large part of the danger. Pigs is pigs, and gear dope is gear dope, as far as the public is concerned. Very little distinction between one kind or another has ever existed in the public mind.

It should be realized keenly further that lubrication control is much more difficult among the rank and file of the public who purchase low-priced automobiles than in the higher-priced category. It is notable that the hypoid has previously been pretty well confined to relatively high-priced cars. The unorthodox feature of the hypoid is, of course, that it requires an extraordinarily powerful lubricant for safe lubrication. This tremendous fact should be realized thoroughly by the entire petroleum industry. In reality it is the first time a lubrication requirement of such fine discrimination has existed in motor-car design.

Excerpt from the paper: "Observations on One Year's Lubrication Experience with Hypoids in the Low-Price Brackets, and Related Commentaries," by R. K. Floyd, president, Frank Harris Floyd, Inc., presented at the Fuels and Lubricants National Regional Meeting of the Society, Tulsa, Okla., Sept. 30, 1937.

Design of Cowlings for Air-Cooled Aircraft Engines

By Donald H. Wood

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RECENT work on cowlings for air-cooled engines has been characterized by the correlation of the cooling function of the cowl with the drag-reducing function into a rational design procedure, whereas earlier work was devoted largely to drag reduction and this was a cut-and-try proceeding.

The fundamental relations between the pressures and velocities of the external and internal air flows are discussed here in their relation to the quantity of air available for cooling and the effect on drag.

Experimental results are outlined, and a design procedure is indicated. It is pointed out that certain factors must be determined by the engine manufacturers in order that a rational design of cowl may be laid out.

The shape of the cowling nose is not critical, and the part of the drag that is subject to control is determined by the air flow out the cowl exit. For an efficient cowling and for control of the air flow, the exit is the important part. A procedure is given for designing an efficient skirt and inner cowl which form the exit.

The propeller has an important effect on the flow at low air speeds, but, in general, is insufficient to provide the necessary flow of air required for cooling on the ground. A new type of cowling providing more flow in this condition is discussed.

Finally, the in-line air-cooled engine is mentioned. The cooling problem here is shown to depend on air-flow conditions differing considerably from those of the radial engine. Economical cooling is dependent on the reduction of internal losses, particularly the large turning loss at the entering side of the engine cylinders.

THE major purpose of a cowling installation on an airplane engine is to reduce the drag, or resistance. It is not surprising, then, that the greater part of the energies expended on engine cowlings has been devoted to drag reduction. When it is considered that the engine, if of the air-cooled type, has to be cooled by air flow through the cowl, it becomes of equal importance to consider the cooling problem. Indeed the two parts, drag and cooling, must be taken together in any rational analysis. This combination was not so necessary at the time of the introduction of cowlings with the low horsepowers then available; but, with several times the power being developed in practically the same frontal area, a study of cooling became necessary.

One of the first reactions upon beginning a study of cooling was that the large volume of air passing through the cowl was doing no cooling because it did not come into contact with the hot surfaces but was using up a great amount of energy because of the resistance that it encountered. Little could be done to relieve the situation until the introduction of intercylinder baffles, which provided a powerful addition in that the air was directed where needed, the amount required was greatly reduced (of the order of 1/9), and better cooling was obtained both in lower maxima and better distribution of temperatures. This result is in contrast to many cowling installations without baffles in which higher temperatures were observed after the cowl was in place.

It is not too much to say that the baffles made a cowled engine cool. At present, a cowling without the auxiliary of baffles is scarcely worth serious consideration. Even though a cowl may be satisfactory without baffles, it will most certainly be better with them. The only unbaffled designs at all practicable are in the very low-power installations, where it is to be doubted whether a cowling is even worth while.

It is surprising to note, post facto, that cowling design proceeded for a long time as a cut-and-try process. There have not been reported in engineering literature any attempts to find the fundamental factors involved in the problem, which must always precede the development of the rational design procedure that is the final end in view.

The most recent studies, by the N.A.C.A. at least, have been concerned primarily with these fundamentals and they lead, with remarkable directness, to a design procedure. It is, therefore, the purpose here to discuss this recent work in an attempt to clear up some of the mooted points. It is hoped

[This paper was presented at the National Aircraft Production Meeting of the Society, Los Angeles, Calif., Oct. 7, 1937.]

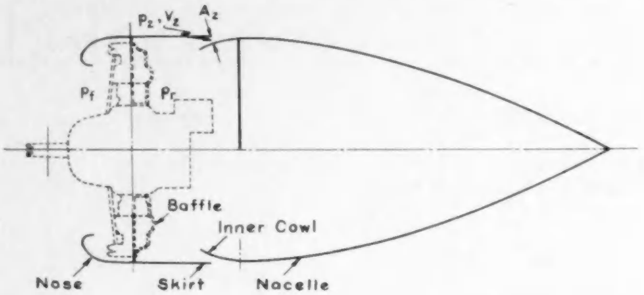


Fig. 1 – N.A.C.A. Cowling – Definition of Terms

that many questions that may be in the minds of those concerned with cowling problems may be answered and that improvements in design may result from a better understanding of the cowling problem. Finally, the question of future work is discussed because no one would be so bold as to ascribe any particular degree of finality to the present state of the art.

The Cowling Problem

The basic idea in mind when cowlings first were introduced was to cover up the exceedingly irregular contours of the engine with a smooth shape, thereby reducing the resistance and yet providing openings for the entrance and exit of air for cooling.

The cowl takes the well-known form shown in Fig. 1. The flow of air divides at the front, a portion passing inside for cooling and the remainder flowing over the outside; the inside flow returns and mixes with the outside flow at the exit. The technical problem is, on the one hand, to determine suitable shapes for the nose that will allow the flow to divide without breaking away from the surface and, on the other hand, to arrange the exit so that the internal flow can return to the outside without serious disturbance at that point and behind it. The solution of the problem is circumscribed by the necessity of providing an internal flow of sufficient volume to cool the engine.

The problem resolves itself into a determination of the pressures and velocities existing at various points in the system and the effect of changes in dimensions on these quantities. Fortunately the various phenomena seem to follow certain well-defined relations, which will now be stated.

Flow Equation

Referring to Fig. 1, at the front there is a pressure due to the velocity of motion of the airplane and at the exit there is a negative pressure due to the fact that the outside flow has not returned to free-air velocity. The total pressure available is then ΔP, which is the total head on the front less the velocity head at the exit. This pressure is, in turn, equal to the pressure drop across the cylinder baffle system (Δp) plus the static pressure at exit (Δp_2).

$$\Delta P = \Delta p + \Delta p_2$$

Otherwise expressed, if H_{T_F} is the total head at the front

$$\Delta P = H_{T_F} - \Delta p_2 = \Delta p + \frac{1}{2}\rho V_2^2$$

The pressure Δp_2 is the velocity head in the exit, $\frac{1}{2}\rho V_2^2$, as the friction loss in the exit passage may be considered negligible.

The flow equation is reduced to a non-dimensional form by dividing by q

$$\frac{\Delta P}{q} = \frac{\Delta p}{q} + \frac{\frac{1}{2}\rho V_2^2}{q} \tag{1}$$

Calling the quantity of air flowing inside Q, then

$$V_2 = \frac{Q}{A_2}$$

where A_2 is the area of the exit opening and, then

$$\frac{\frac{1}{2}\rho V_2^2}{q} = \left(\frac{Q}{A_2 V}\right)^2 \tag{2}$$

Conductivity

In fluid flows the velocity is known to be proportional to the square root of the pressure drop at ordinary velocities. For a given engine baffle system, radiator, or pipe, the volume of flow is proportional to the velocity and the area, i. e., AV, and hence

$$Q = \sqrt{\Delta p}\, AV \times \text{Constant} = \sqrt{\Delta p}\, AVk$$

The constant is analogous to an orifice coefficient, and allows for contraction, non-uniform velocity distribution, and friction.

In the engine cowl system it is difficult to determine the area A in the free stream that is passing the flow into the cowl or the free area between the cylinder fins. It is more convenient to express the area A as a fraction of the total cross-sectional area of the cowl F. The pressure Δp may be expressed in terms of the dynamic pressure, q. There results

$$KF = k$$

and

$$Q = K\sqrt{\frac{\Delta p}{q}}\, FV \tag{3}$$

The constant K has been called "the conductivity of the engine." Equation (3) is fundamental in the problem, as will be shown later.

Equation (3) may be rearranged

$$\frac{\Delta p}{q} = \left(\frac{Q}{KFV}\right)^2$$

Expression (2) may be changed to introduce A_2 in terms of the total cross-section, that is, $A_2 = K_2F$

$$\left(\frac{Q}{A_2V}\right)^2 = \left(\frac{Q}{K_2FV}\right)^2$$

The final form of the flow equation (1) is then

$$\frac{\Delta P}{q} = \left(\frac{Q}{KFV}\right)^2 + \left(\frac{Q}{K_2FV}\right)^2 = \left(\frac{Q}{FV}\right)^2\left(\frac{1}{K^2} + \frac{1}{K_2^2}\right) \tag{4}$$

The total pressure drop available is seen to be independent of the velocity and divides between the engine baffle system and the exit in inverse proportion to the relative conductivities of the engine and exit slot.

With a given cowling and engine baffle system the cooling is proportional to the mass flow of air through the cowl (at constant temperature); that is, for a given cooling, ρQ must be constant.

Hence

$$\rho Q = K\sqrt{\frac{\Delta p}{q}}\, FV\rho$$

$$= K\frac{\Delta p^{1/2}}{\left(\frac{1}{2}\rho V^2\right)^{1/2}} FV\rho$$

$$= K\,\Delta p^{1/2}\rho^{1/2}\sqrt{2}\,F$$

$$\rho Q = \Delta p^{1/2}\rho^{1/2} \times \text{Constant} \tag{5}$$

For constant cooling the product $\rho\Delta p$ must be constant at all air speeds and at constant density Δp must be constant. At altitude, for example, the temperature of the air will be lower and a correspondingly less mass of air will be required but Δp will be greater due to decreased ρ. Owing to the relatively wide temperature and density variations in practice, it is probably better to neglect such changes in the basic design and provide for them by regulation of flow.

As $\rho \Delta p$ required is constant in a given case, it follows that some regulation of flow is necessary to avoid over- and under-cooling. From the flow Equation (4) it is seen that this purpose is accomplished by altering the skirt conductivity K_2 (the skirt opening) to transfer a greater or less part of the total pressure drop to the cylinder baffle system. This alteration may be by the use of cowl, flaps, or other area-changing devices.

Pumping Efficiency

The foregoing constitutes the basic picture of the N.A.C.A. cowling. As far as its internal characteristics are concerned, it is essentially a pump operating on a pressure difference of about 1 q to 1.3 q, the exit slot, by variation in size, constituting a valve for flow regulation. It remains to establish the energy characteristics of this pump in their relation to the drag of the cowling.

The useful work done by the air passing through is equal to the product of the quantity of air and the pressure drop across the cylinder and baffles, that is, $Q\Delta p$. If the cowling exit slot is closed completely, no air flows through, but some changes in flow around the nose may occur due to backing up of the pressure inside. Some basic shape is, therefore, indicated for comparison. It might be considered that a streamline form should be used to give this ideal case. All practical cowls being flat on the front, however, a nose closed by a flat plate has been used as a basic shape for comparison. The drag of this shape is called D_0, and the drag of any other shape with air flow, D. The added work due to the change of shape and air flow is then $(D - D_0)V$. The pumping efficiency is then

$$\eta_p = \frac{Q\Delta p}{(D - D_0)\, V} \tag{6}$$

This efficiency is not a true efficiency in the commonly used sense and may assume values over 100 per cent because of the arbitrary choice of the shape for D_0. Its usefulness lies in the fact that the relative merits of various cowls may be assessed in a simple manner, as will appear later.

It is convenient to represent the drag in coefficient form. Introducing coefficients,

$$Q = K\sqrt{\frac{\Delta p}{q}}\, FV \tag{3}$$

$$Q\Delta p = K\left(\frac{\Delta p}{q}\right)^{1/2} FV\,\Delta p$$

and

$$\eta_p = \frac{K\left(\frac{\Delta p}{q}\right)^{1/2} F\,V\,\Delta p}{\left(C_D - C_{D_0}\right) q\,F\,V} = K\left(\frac{\Delta p}{q}\right)^{3/2} \frac{1}{C_D - C_{D_0}} \tag{7}$$

The equations (3), (5), and (6) or (7) constitute the fundamental relations among the quantities involved in the cowling problem. They are set forth in greater detail in a published report[1] which is recommended for careful study.

Experimental Results

The fundamental equations expressing the relation between the variables having been established, experiments are required to determine the constants of various possible arrangements. The experiments reported in N.A.C.A. report 592[1] yield the required information.

The pressure Δp is determined by measuring the total head in front of the engine cylinders (p_f) and the static pressure in the space behind the baffles (p_r). The velocity here is very low and the velocity head small, $\Delta p = p_f - p_r$. The quantity Q is most conveniently determined by a survey of velocity across the exit slot. Here the velocity is high enough to give reliable readings on a manometer. The constant K is determined from Δp and Q by Equation (3). The drag (D), which may be measured simultaneously, and the drag (D_0) of the closed basic shape previously found from Equation (6), together with the values of Q and Δp, determine the pumping efficiency. At the same time, certain temperature measurements are made for later use in determining the relative cooling of various cowling arrangements.

The foregoing factors have been determined for a large number of arrangements.[1] In order to show certain features of these results, it is convenient to plot the pressure drop across the cylinder baffle system ($\Delta p/q$) against the drag coefficient for constant values of the engine conductivity, K. The conductivity is largely determined by the engine-cylinder fins and the inter-cylinder baffles. In the tests reported, several values of the conductivity were produced by altering the baffle arrangements with a given engine-cylinder design. In general, the conductivity will be different for different designs of cylinder, even with the tightest baffles. Before the design of a cowling can proceed, it is necessary to determine the conductivity for the particular engine and baffle arrangement and the pressure drop or the quantity of air required for proper cooling. This determination is logically a duty of the engine manufacturer.

The plot of Fig. 2 shows the values of the drag coefficient as a function of the pressure drop for two conductivities and for two sizes of the engine nacelle behind the cowling-exit slot. The spots plotted represent most of the forms tested and tabulated in Report No. 592.[1] A few of the shapes are indicated in Fig. 3. Where several points with the same number are indicated, the skirt was cut off to give different openings and pressure drops.

It is to be noted that, regardless of the shape of the nose, except the nose on cowl 5, the results for a given conductivity follow close to a single line, passing through zero at the drag coefficient corresponding to the closed exit slot. The pressure drop is seen to be a function of the exit opening.

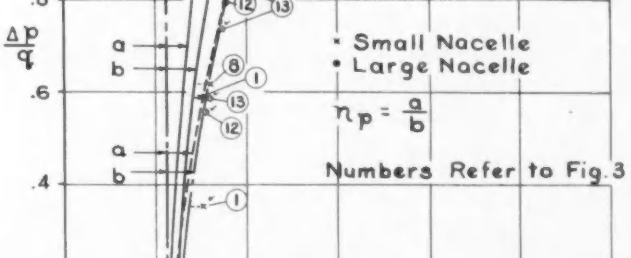


Fig. 2 - Pressure Drop, Pump Efficiency and Drag

[1] See N.A.C.A. Technical Report No. 592, 1937: "Full-Scale Tests of N.A.C.A. Cowlings," by Theodore Theodorsen, M. J. Brevoort, and George W. Stickle.

Lines of $K(\Delta p/q)^{3/2}$ also have been drawn in on the plot. In accordance with the definition of the pumping efficiency, these lines pass through zero at the drag coefficient $C_D = 0.1115$ corresponding to the closed basic shape. A vertical line is drawn through this point and the pumping efficiency at any value of $\Delta p/q$ is the ratio of the horizontal intercepts (a/b). For the smaller conductivity $K = 0.0424$, the efficiency is about 50 per cent at $\Delta p/q = 1$ and remains close to this value to low values of $\Delta p/q$, finally becoming zero, of course, at zero $\Delta p/q$. For $K = 0.0909$ the efficiency is nearly 100 per cent. At values of $\Delta p/q$ greater than 1, the pumping efficiency falls off to low values. The large nacelle, providing a better exit form, shows higher efficiency.

It will be noted that, whereas the original data show some variations of pumping efficiency, the points are all near enough to the line so that, for practical purposes, a single value may be used for a large range of pressure drops. This result comes about because the cooling drag with which the pumping efficiency deals is only a part of the total drag. At a $\Delta p/q$ of 1.0, a 1 per cent change in η_p, causes only 1/3 per cent change in drag and, at $\Delta p/q = 0.3$, a 1 per cent change in η_p causes only 1/6 per cent change in drag. To be strictly correct, however, each particular point has a unique value of pumping efficiency owing to the fact that, if the skirt opening is changed purely by changing its angle, there is a corresponding change in the pumping efficiency. The widest departures are for Cowls 1 and 8, and the skirt on these cowls must be classed as poor. By a suitable design, however, it should be possible to retain about the same efficiency for all pressure drops. A method by which this result may be accomplished will be indicated later. The drag may, in the majority of cases, be read from the curve and the pumping efficiency need not be calculated. Its fundamental importance, however, must not be lost sight of.

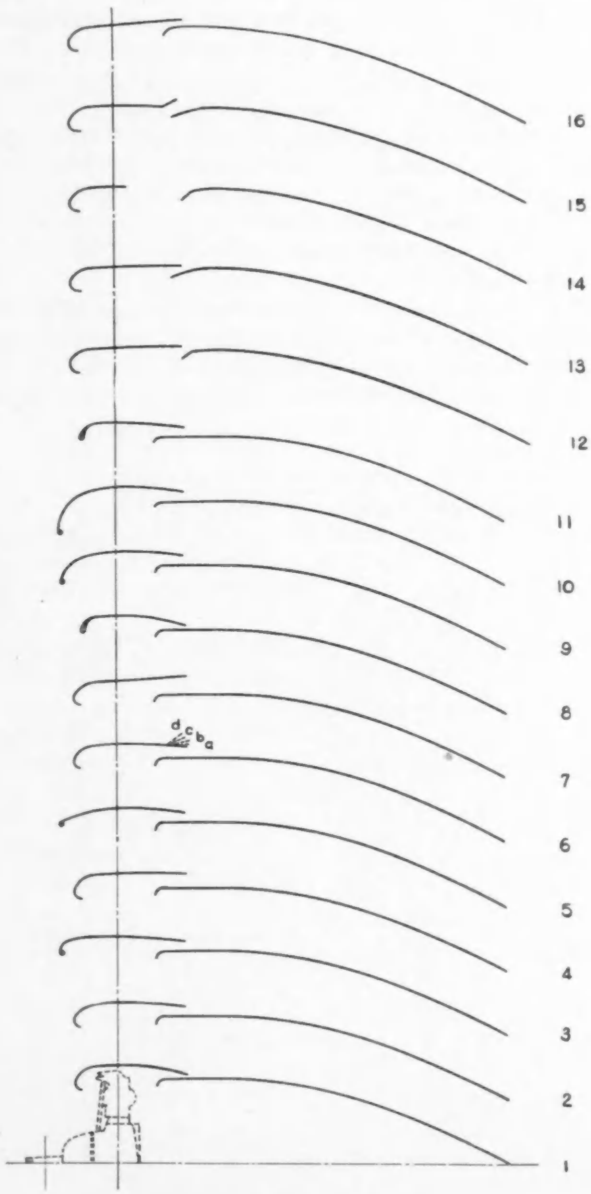


Fig. 3 - Cowling Forms

The variation of $\Delta p/q$ with exit opening is clearly indicated by comparing the curves with the shapes in Fig. 3. Small openings produce a small pressure, and large openings, a greater pressure. It is noted that little pressure is gained above $\Delta p/q = 1.15$ (maximum, 1.24), and this gain at the expense of a great increase in drag. The variation in $\Delta p/q$ encountered in a typical problem is illustrated by the following example:

For an engine with Wasp "G" cylinders and tight baffles $(K = 0.042)$, tests indicate that a pressure drop of 2.6 in. of water is sufficient to hold the temperature rise of the hottest point to 400 deg. fahr. at standard sea-level density and temperature ($\rho = 0.002378$, $t = 59$ deg. fahr.).

Then $\Delta p = 2.6 \times 5.2 = 13.5$ lb. per sq. ft. Assume an airplane with a high speed of 200 m.p.h. Then

$$\frac{\Delta p}{q} = \frac{13.5}{102.3} = 0.132$$

is required and the exit opening may be made correspondingly small. It is now of interest to see at what speed the same cooling could be obtained with the maximum pressure available ($\Delta p/q = 1.24$).

Now $$\frac{13.5}{q} = 1.24$$

and $$q = \frac{13.5}{1.24} = 10.9$$

This corresponds to

$$V = \sqrt{\frac{2q}{\rho}} = \sqrt{\frac{2 \times 10.9}{0.002378}} = 95.7 \text{ ft. per sec.}$$
$$= 65.2 \text{ m.p.h.}$$

The best climbing speed is normally about 60 per cent of the high speed or, in this case, 120 m.p.h. The cooling in full-throttle climb is usually the most critical for land planes and it is seen that the cooling is adequate to well below this speed. In fact, at 120 m.p.h., $q = 36.8$ lb. per sq. ft., the $\Delta p/q$ required is only $\frac{13.5}{36.8} = 0.367$.

The drag added by the increase in pressure drop begins to be disproportionately large at a value of $\Delta p/q$ of about 1.15. The drag coefficient here is $C_D = 0.233$. The speed corresponding is

$$V = 200\sqrt{\frac{13.5}{1.15 \times 102.3}} = 67.7 \text{ m.p.h.}$$

Thus, the drag becomes $\frac{0.475}{0.233} = 2.04$ times for a reduction of speed for adequate cooling of $1 - \frac{65.2}{67.7} = 0.037$ or 2.5 m.p.h., certainly very poor.

The foregoing results indicate adequate cooling at quite low speeds. If K is 0.06, corresponding to standard baffles ($\Delta p/q = 1.15$, $\Delta p = 24.5$ lb. per sq. ft.), the minimum speed for adequate cooling is 91 m.p.h.; and, if K is 0.09, corresponding to very loose baffles ($\Delta p/q = 1.15$, $\Delta p = 28$ lb. per sq. ft.), the

minimum speed is 105 m.p.h. for the example engine. The advantage of tight baffling is very evident. The same effects are in evidence at high speeds, but here the small drag increase, due to the internal flow, reduces the advantages; although, even at 200 m.p.h., a reduction of 10 per cent in the nacelle drag is attendant upon the use of tight instead of loose baffles.

Cowl Flaps

The small pressure increase with large exit openings has been used as an argument against cowl flaps. The part of the curve above $\Delta p/q = 1.19$ in Fig. 2 corresponds entirely to cowls with the trailing edges definitely turned outward, which pictures of installations with cowl flaps always seem to indicate. It is to be noted that, in the cowls discussed here, the skirt edge is always outside the nacelle line behind it, whereas in many installations the cowling edge and nacelle are practically in line, with flap neutral. This fact constitutes a different design of exit slot, and it is observed that pressure drops corresponding to the present values with a straight skirt were obtained by Beisel with the flap pulled in somewhat.[2] The important fact is not that the flaps go out but that they can be moved in and out, providing a control. The circumstance that they appear to be out is only an indication of one position in their range, and this position is where they operate on the ground and at low speeds in the air. When the practical questions involved in the design of a simple, light mechanism for control of the exit area are considered, it is apparent that the cowl flap is a reasonable solution consistent with the demands made upon it. The fact that the efficiency is poor in the extreme outward positions is secondary.

Analysis of Drag Components

It is apparent from the preceding remarks that the drag of the completely cowled nacelle may be considered to be made up of the drag of a basic shape with no internal air flow and an added drag depending in magnitude on the pressure drop through the engine or, what amounts to the same thing in a given case, on the quantity of air flowing through. The skirt opening determines this quantity, and the exit design determines the efficiency with which the flow occurs, and hence the added drag. Although changing the nose shape undoubtedly is responsible for some small variations, their effect is evidently very small and only shows departure from the main trend in a few cases, and these always are poorer than the general run. The well-rounded nose seems to yield the best results, and there is little to be gained by minor changes in this part of the cowl. It is also clear that the opening should be as large as possible consistent with nose rounding.

The final operable cowling represents a considerable departure from the shape that would be used if merely a housing had to be provided for the engine; it is of interest to see just how much is being paid in drag in departing from a streamline form apart from the drag due to internal air flow. Fig. 4 provides a comparison representing the various steps from the streamline nacelle to an operable cowled nacelle. The streamline form has a drag coefficient of $C_D = 0.0861$ under the same conditions as the other tests discussed here. When the nose is made flat, the coefficient becomes $C_D = 0.1115$, an increase of 29.5 per cent; when the nose is opened the coefficient is $C_D = 0.1193$, a further increase of 9 per cent or a total of 38.5 per cent. In these three cases there is really no internal pressure difference, and the plotting indicated is mere illustrative. When the skirt is opened but with air flow prevented by an internal plate, there is a pressure difference developed; but the resulting drag is attributable to the distortion of shape by the

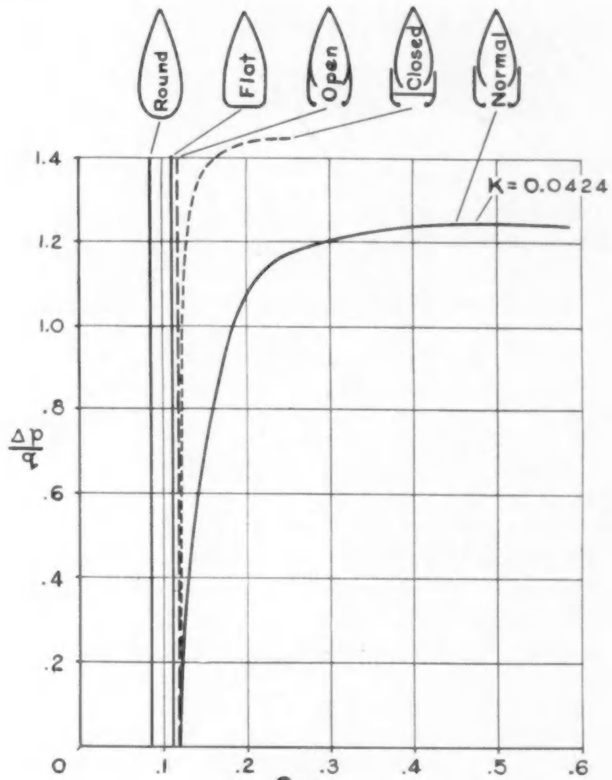


Fig. 4 – Effect of Nose, Exit Slot, and Air Flow on Drag

skirt opening, there being no internal flow. The added drag is small, becoming only 2.5 per cent at $\Delta p/q = 1.2$. Finally, the line for the operable cowl with $K = 0.0424$ is repeated from Fig. 3. It is seen that, at low pressure drops (high speed), the internal air flow is responsible for only a small part of the cowl drag; whereas, at high pressure drops, it is chargeable with 50 per cent or more of the drag. Even here the energy required is not large.

For example, using data from the previous example and the following:

Engine diameter = 52 in. $F = 14.7$ sq. ft.
Engine power = 550 hp.

Case 1.— $\frac{\Delta p}{q}$ (200 m.p.h.) $= 0.132$; $C_D = 0.122$; $q = 102.3$

Case 2.— $\frac{\Delta p}{q}$ (68 m.p.h.) $= 1.15$; $C_D = 0.233$; $q = 11.8$

$$\text{Power required due to internal cooling flow} = \frac{\Delta C_D q F V}{550}$$

$$\text{Case 1.— } (0.122 - 0.1193)\ 102.3 \times 14.7 \times \frac{293.5}{550} = 2.16 \text{ hp.}$$

$$\text{Case 2.— } (0.233 - 0.1193)\ 11.8 \times 14.7 \times \frac{99.7}{550} = 3.56 \text{ hp.}$$

As a percentage of the engine power these become

$$\text{Case 1.— } \frac{2.16}{550} \times 100 = 0.39 \text{ per cent}$$

$$\text{Case 2.— } \frac{3.56}{550} \times 100 = 0.65 \text{ per cent}$$

The power required for maintaining cooling is thus quite small, but it must be remembered that, in the cases cited, the flow was kept at $\Delta p = 13.5$ lb. per sq. ft. by skirt-opening adjustment. Were it sufficient to cool in climb at 120 m.p.h. ($\Delta p/q = 0.367$; $C_D = 0.130$), the power for cooling would be $(0.130 - 0.1193)\ 36.8 \times 14.7 \times \frac{176}{550} = 1.85$ hp. or $\frac{1.85}{550} \times 100 = 0.34$ per cent of the engine power. If the cowl is not

[2] See *Journal of the Aeronautical Sciences*, March, 1937, pp. 185-191: "Why Use Cowl Flaps," by Rex B. Beisel.

adjusted, the $\Delta p/q$ remains the same and, at 200 m.p.h., the power for cooling is

$$(0.130 - 0.1193)\ 102.3 \times 14.7 \times \frac{293.5}{550} = 8.6 \text{ hp.}$$

or simply $1.85 \times \left(\frac{200}{120}\right)^3 = 8.6$ hp. which is $\frac{8.6}{550} \times 100 = 1.6$ per cent of the engine power.

This value becomes 5.4 per cent at 300 m.p.h. The importance of controlling the air flow, particularly at high speed, can not be overstressed. This result is of even greater importance than may appear from the examples. These examples were worked out for the tightest baffles ($K = 0.042$), and hence most efficient cooling. With looser baffling or deeper finning, K increases, and the power required for cooling may be greater even at the best conditions. It is not quite proportional to the conductivity because the pumping efficiency is greater at higher values of K. In the last case cited previously, if K is 0.06, the $\Delta p/q$ required in climb is 0.666, and $C_D = 0.153$. The percentage of power used in cooling is 1.1 per cent compared with 0.34 per cent for $K = 0.042$. If the cowl is not adjusted at 200 m.p.h., the percentage of power for cooling is $1.1 \times \left(\frac{200}{120}\right)^3 = 5.3$ per cent compared with 1.6 per cent. At higher values of K, such as occur with the larger two-row engines, wherein K may reach 0.15 or more, the control of the flow can not be foregone unless the purpose of the cowl is to be largely defeated.

A nice question is raised as to what constitutes the power required for cooling. It may be argued that the distortions of the streamline shape are, in fact, brought about by the necessity of cooling and, accordingly, the whole drag above that of the streamline form is chargeable to cooling. It may be stated with equal force that, if the engine merely has to be housed, which is all the streamline form can do, the sensible thing to do is to house it in the wing. Hence, the whole nacelle drag is chargeable to cooling. Other variations on this theme are noted from time to time. It is really of small moment what is defined as cooling power so long as it is defined clearly whenever discussed. However, there is a certain advantage in having a standard. The method given here is recommended for consideration because it speaks of the actual power due to internal (cooling) air flow as a separate entity and, at the same time, recognizes the existence of other factors which produce drag and which must be included in any comparison with other types of engine installation.

The Design of the Exit

Much has been said of the exit. Its importance in securing an efficient cowling and as a control for the cooling air has been stressed, and the general conditions to be met have been indicated. There are, however, some design considerations that merit further discussion.

The cooling air, having left the baffle exit, expands into the relatively large space behind the engine and slows down to a low velocity. It then has to accelerate out through the exit opening and enter the outside air stream. Owing to the low velocity inside, the inner cowl does not have to be carried very far inside in order to be effective in guiding the air toward the exit. Its main purpose is to provide a uniformity and direction to the stream so that the air will not flow in an irregular way and, in leaving, will not impinge too sharply on the outside flow and produce large impact losses.

The exit velocity assumes a wide range of values depending on the size of the exit opening and the quantity of air. When the opening is small and the exit velocity is high, it is important to get the air out nearly parallel to the external flow. With large openings and low velocity this result is not so important because any impact will be correspondingly weaker but, in general, the mixing of the streams should occur in an orderly manner and the attempt should be made to bring the streams together nearly parallel to each other under all conditions. Then, as the air which has passed out the exit proceeds along the cowl, it will be accelerated gradually to the velocity of the outside stream and, finally, the two streams practically will merge into one.

A qualitative picture of desirable conditions is obtained if the boundary of the external flow is considered to be the backward prolongation of the skirt line and the boundaries of the internal flow are this line and the inner cowl. The two lines should gradually approach each other as the air is increasing in velocity. It is fairly obvious that there should be no sharp breaks in the contours. The inner cowl and the inside of the skirt should be smooth and free of protuberances causing breakaway and blocking of flow. Exhaust collectors and other paraphernalia should not be placed directly in the exit.

The most desirable conditions can not be fulfilled exactly throughout the complete range of operation in a given installation. But, if attention is directed to the condition where best performance is desired, the losses at other conditions will not be intolerable. The evidence points to a neglect of the exit design in the past when every cowling skirt was a fertile field for the shears and hammer. In the light of present knowledge, the exit design can be improved greatly with a resulting increase in cowling efficiency. Accordingly, a procedure that may be useful in this problem follows: At the design condition there is known, or assumed, the air speed, V; the density, ρ; the pressure drop required for safe cooling, Δp; the conductivity of the engine, K; and the engine dimensions. From Equation (3) the quantity of air, Q, is calculated. The required exit area is then obtained from a solution of the flow Equation (4). The flow equation indicates that the total pressure available is independent of air speed and it might be assumed constant. However, examination of the available data indicates that the total pressure is not, in fact, constant under all conditions and there is some effect of the internal flow. At low flows the total pressure is about 1 q and at the highest flows about 1.3 q. The following empirical formula seems to fit the results closely in most cases,

$$\frac{\Delta P}{q} = 1 + 0.23\,\frac{\Delta p}{q} \tag{8}$$

This formula is applicable throughout the pressure range but excludes cases with the bent-in skirt (cowlings 1 and 8 in Fig. 3), which show poor efficiency and are to be avoided.

The solution for K_2 and $A_2 = K_2F$ may be completed using the empirical formula of Equation (8) with the flow Equation (4), or alternately, $V_2^2 = V^2 - \frac{1.54\,\Delta p}{\rho}$ and $A_2 = \frac{Q}{V_2}$. This equation for V_2 results from combining Equations (1) and (8).

The area, A_2, is the minimum area measured from the end of the skirt perpendicular to the inner cowl. This area may be used either to fix the location of the end of the skirt with a given inner cowl or to fix a point of the inner cowl with a given skirt. For purposes of design layout the width giving the required area is calculated. The line of the skirt may be assumed parallel to the crankshaft for best results, but it may run out or run in slightly if the inner cowl is fixed by other considerations, that is, clearing auxiliaries, and so on.

The next step is to establish another point on the inner cowl for the maximum diameter of the nacelle. This step involves making the area (called A_3) between the prolongation of the skirt (the line dividing the flows previously discussed) and the

nacelle such that the velocity is the same as that outside. The outside velocity is, in general, undetermined but examination of pressure plots and surveys of velocity indicate that it is of the order of 1.1 times the free air velocity, V. This factor is probably somewhat low for low speeds with propeller operating but, in the ordinary range, it is sufficiently accurate. If it were unity, the area would be 10 per cent larger, but the nacelle diameter would be changed only slightly. The area is then

$$A_3 = \frac{Q}{1.10\ V}$$

or

$$A_3 = A_2 \times \frac{V_2}{1.10\ V}$$

The width giving this area is calculated, making use of the diameter of the flow line at the point opposite where the maximum diameter is to be.

A smooth curve may now be drawn through the two points on the inner cowl fairing into the nacelle line. The cowling design is thus completed for the assumed conditions. A check at other conditions will determine whether the design is satisfactory, recognizing that the areas must be altered at other speeds. It will be found that the nacelle and inner-cowl diameters will be different at the several speeds with a fixed skirt. It is impractical to alter these parts in flight and the flow change must be accomplished by changing the length or the angle of the skirt. Changing the length is probably better but not as practical as changing the angle.

In order to show how the operations just described work out, a calculation has been made of a cowl for a 550-hp. engine, 52 in. in diameter, with standard baffles, $K = 0.060$. The computations have been made for various speeds in standard air ($\rho = 0.002378$, $\Delta p = 24.5$ lb. per sq. ft.). The shapes arrived at are indicated in Fig. 5, and the pertinent results are given in the table following:

Air speed, (m.p.h.)	$\frac{\Delta p}{q}$	$\frac{\Delta P}{q}$	K_2	A_2, sq. in.	Inner cowl diameter at exit, in.	Maximum nacelle diameter, in.
90	1.19	1.28	0.223	473	45.9	50.5
100	0.96	1.22	0.115	244	48.9	50.6
150	0.42	1.10	0.048	101	50.8	51.1
200	0.24	1.06	0.032	69	51.2	51.4
250	0.15	1.04	0.025	53	51.4	51.5
300	0.11	1.02	0.020	43	51.5	51.6

The figure has been drawn using the dimensions for the inner cowl and nacelle diameters calculated for the 100 m.p.h. speed with the required exit area obtained by varying the skirt length (solid lines) or by flaring the rear part of the long skirt (dotted lines). The table indicates the values calculated for the best conditions. It is seen that nacelle would be only 1 in. larger if designed for 300 m.p.h. instead of 100 m.p.h. Using the smaller diameter simply means that the flow runs farther along the nacelle before the velocities equalize. If the large diameter nacelle is used, the skirt lengths are correspondingly shortened or the flare increased. The small scale of the drawing does not show the differences as clearly as might be, however, particularly the small change in opening required from 200 to 300 m.p.h.

Effect of Propeller

The discussion thus far has been confined to the cowling without propellers. As all applications have a propeller operating immediately in front of the cowling, it is important to inquire into its effects. Indeed, it may be wondered why this investigation was not done at the outset, including the whole system in the inquiry from the start. The excuse is that the complication of the problem requires some simplification and also that the propeller plays a relatively minor role, as will appear shortly.

It is well known that the propeller produces a thrust, which has as a reaction an increase in the momentum of the air passing through its disc. Immediately behind the propeller there is an increase in pressure, which converts to a higher velocity (momentum) downstream. It may be expected that the pressure increase would produce additional pressure at the front of the cowl. Actually, the thrust is not uniformly distributed

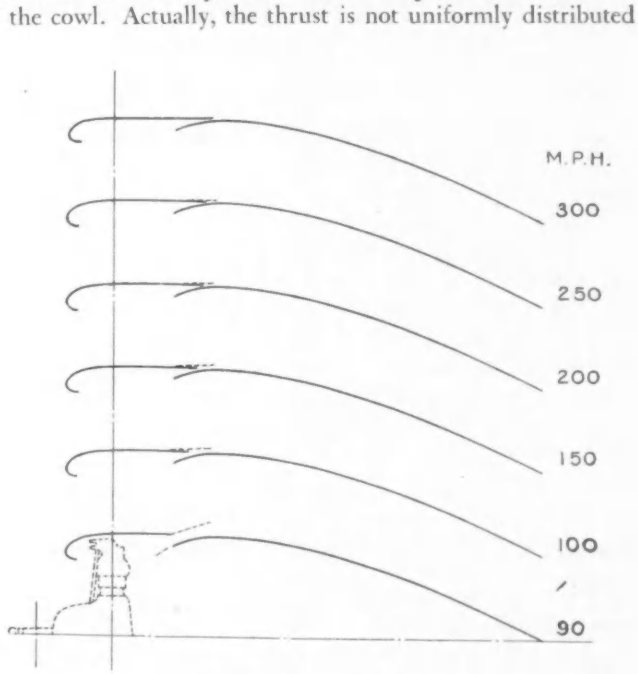


Fig. 5 – Example of Exit Design for Several Speeds

over the propeller disc, being zero at the center, gradually rising to a maximum at about ¾ of the radius, and then falling rapidly to zero again at the edge. Furthermore, the hub occupies a considerable area near the center and commonly produces a negative thrust or drag. With the propeller operating, the front pressure is found to be less than without it, but the suction at the exit is somewhat greater due to the increased velocity at this point which is passed by air coming from farther out on the propeller. The total pressure is then not much different with the propeller operating except at low velocities.

The increase in momentum, or the thrust, is a function of the revolution speed, n, and the forward speed, V, and is commonly given as a function of V/nD. The thrust or momentum is proportional to n^2 and so the pressure is also. The pressure coefficient of the cowling may be expressed, therefore, as p/n^2 as a function of V/nD; but, to avoid the use of small decimals, $\frac{\sqrt{\Delta p}}{n}$ is found more convenient. The value Δp is the pressure drop across the engine as before.

The plot of Fig. 6 shows a typical set of results[3] for several settings of the propeller. It is noted that, over a considerable range at the higher values of V/nD, the curves are straight and the square root of the pressure drop is proportional to V/nD, that is, if the revolution speed is constant, Δp is proportional to V^2, or to q, just as it was without a propeller. At lower speeds the pressure is relatively higher. This result is of considerable importance for cooling at low speeds.

The cowlings tested were designed around a 550-hp., 52-in. diameter engine, and the 10-ft. diameter, three-blade propeller

[3] See N.A.C.A. Technical Report No. 593, 1937: "Cooling of Airplane Engines at Low Air Speeds," by Theodore Theodorsen, M. J. Brevoort, and George W. Stickle.

is close to the size that would be required for this engine, geared 3:2, to turn the propeller at 1400 r.p.m., at full power. The Δp corresponding to an assumed velocity may be computed from the $\Delta p/q$ for this cowling without a propeller. Inserting the assumed value of $n = 1400/60$ and $D = 10$, a value of V/nD corresponding to the velocity is calculated. This value of V/nD is plotted against the square root of the pressure Δp divided by n and the straight line is drawn through the point and zero and shown dotted on Fig. 6. Δp varies as q or V^2 so that $\sqrt{\Delta p}$ is a linear function of V or V/nD for constant n. This line allows a comparison of the pressures available with and without propeller to be made *for this particular case.*

As the pressure coefficient without propeller is a linear function of V/nD, a convenient method for locating the line for other conditions is to compute the value of V/nD and $\frac{\sqrt{\Delta p}}{n}$ for 100 m.p.h.

$$\frac{V}{nD_{100}} = \frac{100 \times \frac{88}{60}}{\frac{N}{60} \times D} = \frac{8800}{ND}$$

and $\Delta p = \frac{\Delta p}{q} \times q_{100} = \frac{\Delta p}{q} \times 25.57$ ($\Delta p/q$ from Fig. 2)

$$\frac{\sqrt{\Delta p}}{n_{100}} = \frac{\sqrt{\Delta p_{100}}}{N/60} = \frac{60\sqrt{\frac{\Delta p}{q}}\sqrt{25.57}}{N}$$

$$= 303.5\sqrt{\frac{\Delta p}{q}}\frac{1}{N}$$

Plotting the point $\frac{\sqrt{\Delta p_{100}}}{n}$ against V/nD_{100} and drawing a straight line through the point and zero give the line for comparison at the new r.p.m.

It is noted that in the cruising and high-speed range the effect of the propeller is to reduce the pressure slightly but, at low speeds, there is a much greater pressure available. For example, at $V/nD = 0$ (zero velocity) $\frac{\sqrt{\Delta p}}{n} = 0.201$ at a 25-deg. blade setting. If $N = 1400$, $n = \frac{1400}{60} = 23.35$, we have

$$\frac{\sqrt{\Delta p}}{n} = \frac{\sqrt{\Delta p}}{23.35} = 0.201$$

$$\sqrt{\Delta p} = 4.68 \qquad \Delta p = 21.9 \text{ lb. per sq. ft.}$$

The engine under discussion has been shown to have cooled with $\Delta p = 13.5$ lb. per sq. ft. with tight baffles. There is, therefore, a good possibility that it would cool on the ground at full throttle. With standard baffles $\Delta p = 24.5$ lb. per sq. ft. so that it would not quite cool on the ground. With the propeller removed, the cooling is zero, of course.

The importance of the propeller in ground-cooling is beyond question. With engines of higher conductivity the cooling will not be adequate, although the situation is not so bad as may be thought for, with better cylinder finning, the pressure drop required is less than for the subject engine even at a higher conductivity. In general, it may be said that the cooling of engines on the ground is not satisfactory and, although the propeller is very helpful, it can not make up for deficiencies in the engine.

In this connection it is of interest to note that a propeller with auxiliary fan showed a value of $\frac{\sqrt{\Delta p}}{n} = 0.243$, which means a Δp available of $\left(\frac{0.243}{0.201}\right)^2 = 1.46$ times the preceding value or

$$\Delta p = 21.9 \times 1.46 = 32.0 \text{ lb. per sq. ft.}$$

With a cowl flap the maximum $\frac{\sqrt{\Delta p}}{n}$ obtained was 0.214 and

$$\Delta p = \left(\frac{0.214}{0.201}\right)^2 \times 21.9 = 1.13 \times 21.9 = 24.8 \text{ lb. per sq. ft.}$$

The engine discussed here requires about $\Delta p = 24.5$ lb. per sq. ft. for cooling and is reported to cool on the ground with flaps open, as the preceding pressure calculation indicates that it should. The fan is even more effective but is not recommended in its simple form because of a loss in net efficiency attending its use at high speeds when it is not needed.

The estimates just made are not quite correct because account was not taken of the ability of the engine to turn the propeller at the 25-deg. blade setting at the assumed value of 1400 r.p.m. This correction requires a knowledge of the power coefficient of the propeller $\left(C_P = \frac{P}{\rho n^3 D^5}\right)$. The data necessary for the condition $V/n\,D = 0$ have been plotted in Fig. 7 as $\frac{\sqrt{\Delta p}}{n}$ against $\sqrt{C_P}$. The point corresponding to 550 hp. at 1400 r.p.m. has been marked and it is noted that the engine can not turn the propeller at 1400 r.p.m. at a blade setting above about 21 deg. where the pressure coefficient is $\frac{\sqrt{\Delta p}}{n} = 0.195$. The pressures calculated previously must, therefore, be reduced in the ratio $\left(\frac{0.195}{0.201}\right)^2 = 0.94$. The pressure 24.8 lb. per sq. ft. is then 23.4 lb. per sq. ft., and the cowl is on the borderline for ground-cooling.

The pressure developed is greatest at the highest revolution speed that can be maintained and is, of course, dependent on the particular propeller used. The test for ground-cooling is one of the simplest, requiring only the running of the engine and notation of the temperatures and r.p.m. It is of interest to note that propellers having the blade sections carried in closer to the hub as airfoil sections are more effective than standard propellers with nearly circular sections for some distance out from the hub. In one comparable case the former gave 45 per cent higher pressure on the ground. The example given here is for the type of propeller with airfoil sections carried to the

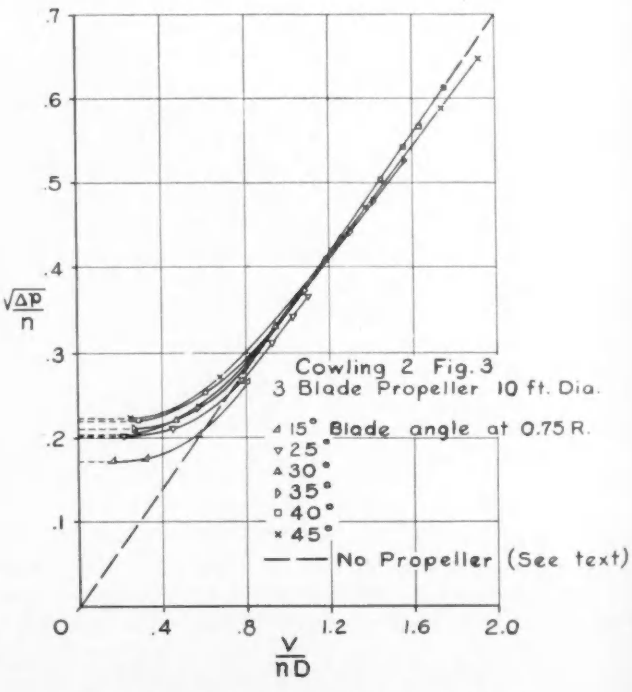


Fig. 6 – Effect of Propeller on Pressure Δp

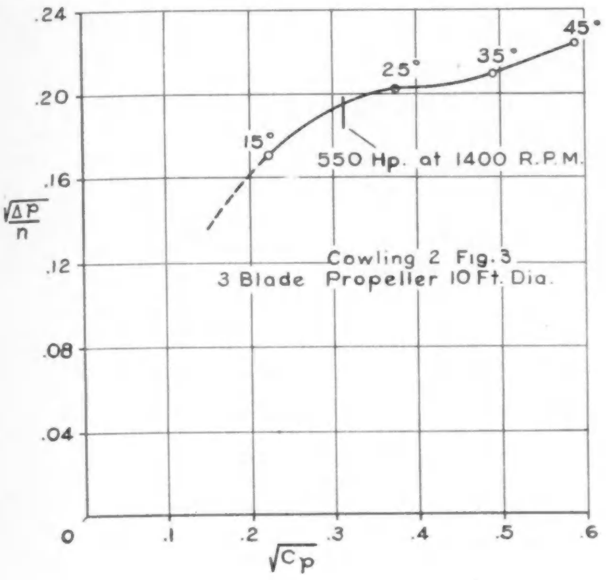


Fig. 7 – Effect of Propeller on Δp at $\frac{V}{nD} = O$

hub. It is apparent then that with standard propellers the cooling will be inadequate.

The pressures do not rise appreciably below a value of V/nD of 0.5, which corresponds to about 70 m.p.h. in the example. Although it is recognized that the full-throttle cooling at standstill is not critical, taxiing at low speeds is, and the cooling limitations hold for all operations on the ground.

Pressures on the Nose

An interesting sidelight on the effect of the propeller is given by the pressure distribution around the cowling nose shown in Fig. 8. The pressure distribution without propeller is also given for comparison. Note the very high positive pressure at the front at the low speeds. To say that $\Delta p/q$ is of the order of 1 q is rather wide of the mark here. At the lowest speed it is about 5.5 q. Indeed, if any pressure at all is developed at zero speed, $\Delta p/q$ is infinite, which illustrates the inadequacy of $\Delta p/q$ designation under these conditions. The gradual shifting forward of the point of zero pressure is noteworthy. Note, however, that this is not the point of zero velocity but rather where the velocity has the free-air velocity. The point of zero velocity (stagnation point) is where the pressure is $+1$ q. Note that this point moves around to the outside and up the cowl nose at the low speeds.

"Nose-Slot" Cowling

The high negative pressure developed further back on the nose ranging from -2.0 to -6.0 q is of great interest. The existence of negative pressures of this magnitude is what started the development of the "nose-slot" type of cowling.[4] The idea is that, if the exit could be located in the region of high negative pressure, a very much larger pressure drop could be made available and with large skirt conductivity, K_2, a large part of this pressure drop would be across the engine. It is evident at once that as soon as air flows into the negative pressure region the negative pressure will become less. Furthermore, the fact that the exit forms a jump in the cowl line causes a change in the pressure diagram. In the preliminary tests reported a maximum $\Delta p/q$ of 2.73 was obtained with no air flow. At $K = 0.04$, $\Delta p/q$ was 1.4. This result compares with $\Delta p/q = 1.24$ for the ordinary cowl and indicates that the exit opening must be larger than it was in the test to make a larger part of the 2.73 q pressure available across the engine. With the propeller operating the pressure coefficient was $\frac{\sqrt{\Delta p}}{n} = 0.28$ with no air flow and 0.18 with $K = 0.046$ in one case. This result compares with $\frac{\sqrt{\Delta p}}{n} = 0.201$ for the ordinary cowl.

Additional experiments on this interesting type have been proceeding for some time. The design is very critical and all that can be said now is that there is some promise of improved cooling at low speeds. Further developments will be awaited with interest by designers of airplanes and engines.

The Engine

The discussion thus far has dealt with the engine as though it were a pipe or passage with some obstructions requiring a pressure to force air through it. It is now proposed to consider what actually occurs in the cylinder baffle system.

It will be noted from Equation (3) that, if $\Delta p/q = 1$, K is the fraction of a column of free air having the diameter of the cowling that passes inside the cowl. As K is of the order of 0.04 to 0.15, it follows that this fraction enters the cowl. At lower values of $\Delta p/q$ a much smaller fraction enters. The area at the front of the cylinders is nearly the same as the total cowling area and, therefore, the small column of air that will enter spreads out and slows down to a low velocity and the pressure at the front of the cylinders is nearly 1 q. In the process of entering and slowing down, the air is observed to execute violent random movements in all directions, some spilling out over the nose at intervals. This motion, analogous to dumping buckets of water into a tub, is not subject to close analysis but is a very important feature of the cowl action and is responsible for the cooling on the front of the cylinders. This cooling is obtained without benefit of baffles, and it is found that the latter do not have to be carried ahead of a point a little back of the centerline of the cylinder.

Upon entering the baffle-fin spaces, the air is speeded up to a high velocity because of the small area of the passages and, in passing around toward the rear, cools the rear part of the cylinders, finally leaves the cylinder at the gap in the baffles, and passes into the space behind and out the exit. The arrangement of the baffles has been the subject of extensive research. The trend has been toward closer-spaced and deeper

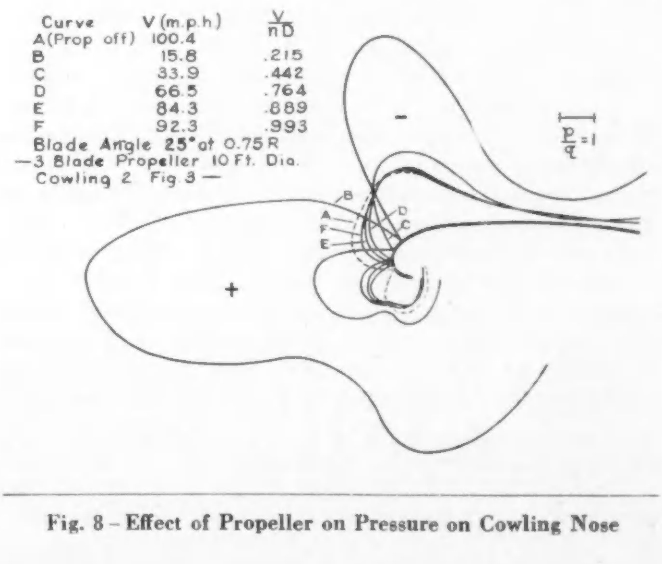


Fig. 8 – Effect of Propeller on Pressure on Cowling Nose

[4] See N.A.C.A. Technical Report No. 595, 1937: "Full-Scale Tests of a New-Type N.A.C.A. Nose-Slot Cowling," by Theodore Theodorsen, M. J. Brevoort, George W. Stickle, and M. N. Gough.

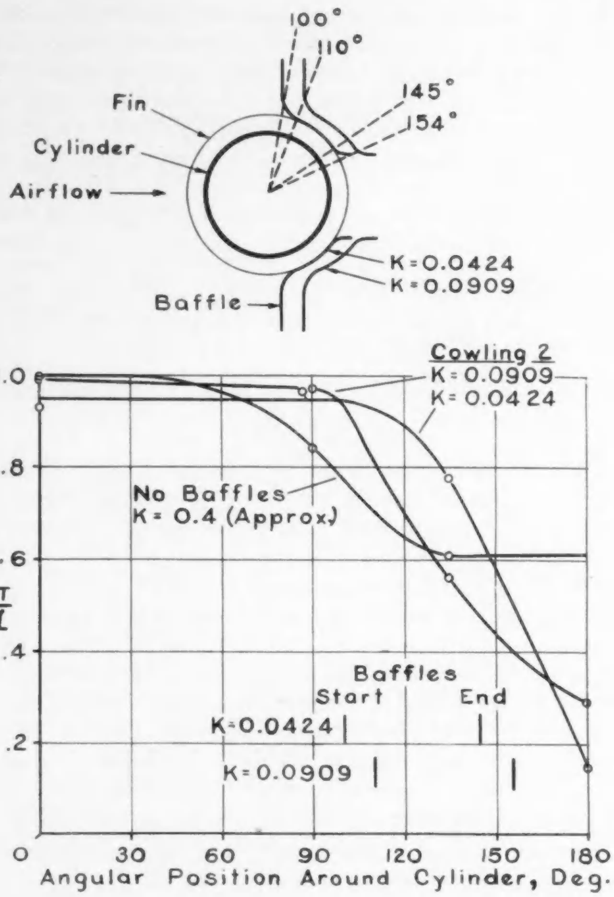


Fig. 9 – Pressure Loss Through Cylinders and Baffles

fins and tighter baffles. It is more than probable that the fin spacing and depth are tied up with the baffle arrangement, and the problem can best be solved by different combinations at various parts of the system.

An important question in this problem is the distribution of the pressure losses and the temperatures around the cylinders. Fig. 9 gives some data obtained by measuring the total head at various points around a cylinder of the cowled engine by means of small impact tubes placed to read the total pressures. Curves are plotted for two conductivities obtained by moving the baffles and a third conductivity with baffles removed. There is evidently no loss back to the entrance to the baffles. Within the baffles there is a loss, but the most surprising thing is that only about one-third of the loss occurs in the cylinders and baffles, the remainder occurring at the baffle exit after the air has done all its useful work. This situation calls for some action for, if the loss could be recovered, the engine could be cooled with one-third the pressure drop and, therefore, one-third of the internal energy normally required. Any fraction that could be recovered would be valuable.

Examination shows that the problem is one of mixing of the streams of air from the two sides of the cylinder and the slowing down of the streams. As the kinetic energy of a moving column of fluid varies as the square of the velocity, three-quarters of the energy is recovered by reducing to half velocity and 15/16 to quarter velocity. It is not worth while to search for the last bit. Some experiments[5,6] indicate that, by altering the baffle and providing an extension to the baffle to form a gradually expanding passage, about half of the lost energy can be recovered with a practical arrangement. Study of the reports detailing these researches is recommended.

The air-flow conditions around the cylinders together with the heat input determine the cylinder temperatures at various points. As engine manufacturers specify the limiting temperature rather definitely, the crux of the cowling problem is to keep the temperatures below the limits. The manufacturer of the engine has to supply the finning and baffles to insure that the temperatures can be kept down in a reasonable cowling. Often the engine is supplied without baffles, and the grief of the cooling devolves on the airplane manufacturer. This situation is largely a thing of the past, for it is almost certain that the present state of performance could not have been attained without the close cooperation of engine and airplane constructors.

Fig. 10 exhibits the distribution of temperature around the cylinder for the same cases as in Fig. 9, and for one additional case with a spinner on the propeller. It is noted that the baffles result in a great improvement in uniformity of temperatures and especially so in the case with a spinner. The latter, which has not been mentioned before, showed the highest efficiency of any cowling tested. The pressure drop is only about 85 per cent of that for the same cowl without spinner; yet the temperatures are lower and more uniform. This result must be due to the covering up of the irregularly shaped, spinning form of the propeller hub, resulting in better flow and also somewhat higher propeller efficiency.

The index temperature used as ordinate is the temperature of a heated cylinder on the engine supplied with a definite quantity of heat. The correlation with the actual engine is that, when tested with the same cowling and baffles, a temperature rise of 73 deg. fahr. was indicated at a point in the rear

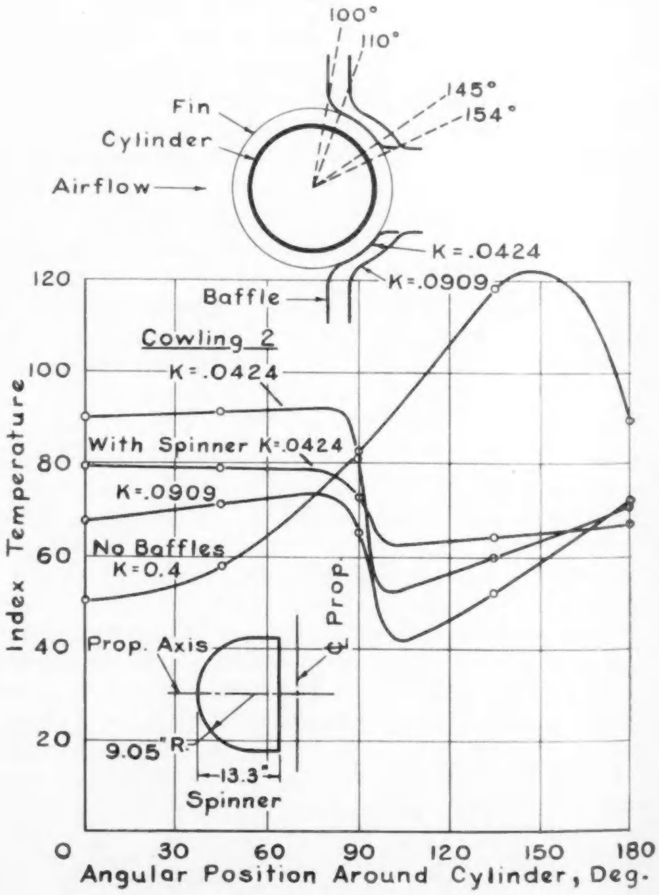


Fig. 10 – Temperature Distribution Around Cylinder

[5] See N.A.C.A. Technical Report No. 511, 1935: "The Effect of Baffles on the Temperature Distribution and Heat-Transfer Coefficients of Finned Cylinders," by Oscar W. Schey and Vern G. Rollin.

[6] See N.A.C.A. Technical Note to be published: "Energy Loss, Velocity Distribution, and Temperature Distribution for a Baffled Cylinder Model," by Maurice J. Brevoort.

of the cylinder barrel when the hottest point on a cylinder-head of the actual engine had a rise of 400 deg. fahr. This result does not mean that 73 deg. fahr. is correct for all engines because they may show quite different relative temperatures between head and barrel and even a different index temperature at the same point on the barrel. The index temperature is merely a point of comparison for a definite engine design and engine power, and the index temperature corresponding to satisfactory cooling will be different for other designs and powers.

Another point of importance in the cooling is the effect of change of the pressure drop. The temperature of the cylinder at various points depends on a number of factors[7] and it is found to vary at $\Delta p^{n}.n$ varies from -0.2 to -0.35. The point it is desired to make here is that, because the temperature is a

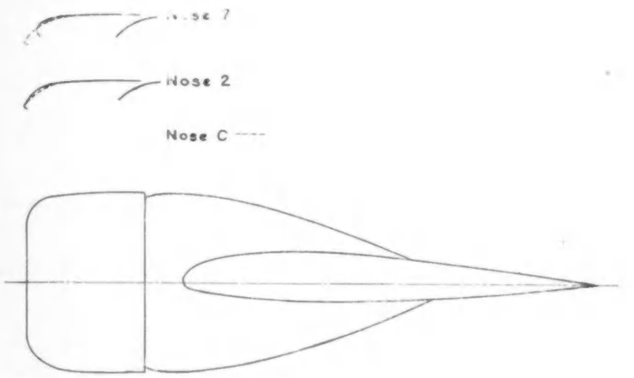


Fig. 11 – Nose Forms Tested at High Speeds

fractional-power function of the pressure drop, a large increase in pressure drop is required to reduce the temperature very much. This fact must be taken into account in cowling designs. If the cooling is very poor, strenuous measures are required to make it satisfactory.

Effect of Air Speed

As a conclusion to the study of radial-engine cowlings, a few results of recent experiments made at high air speeds are presented to show that the cowling in its present form is not limited to present conditions. The tests were made on a model wing-nacelle combination in the N.A.C.A. 8-ft. high-speed wind tunnel. Fig. 11 shows the model arrangement and three cowling nose shapes. Noses 2 and 7 are the same as those on cowlings 9 and 1 in Fig. 3 and nose C is a slight modification of nose 2.

It is well known that, whenever the velocity of sound is reached at a point in a field of flow, a shock wave is produced which manifests itself as a sudden and large increase in resistance. On the nose of the cowling there are areas over which the air is passing at considerably more than free-air velocity. Referring back to Fig. 8 the maximum negative pressure is about $-2\ q$, which indicates that at that point the velocity is

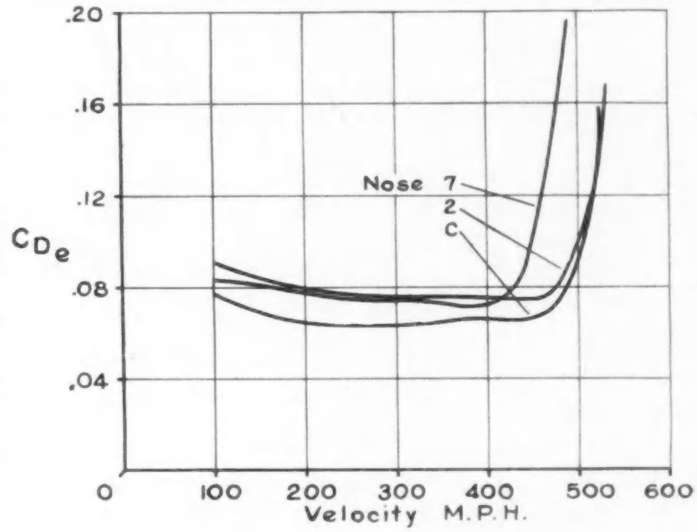


Fig. 12 – Effect of Speed on Nacelle Drag

about 1.73 times the free-air velocity. Assuming the velocity of sound is 1120 ft. per sec. (this value depends on density and temperature) the free air speed is 647 ft. per sec. (443 m.p.h.) when the shock wave starts on the cowl. Beyond this speed the air becomes in effect a stone wall, the drag increasing at an enormous rate, exceeding the limits of the measuring scales, and of any power likely to be available in an airplane.

If the curvature of the nose is reduced in the region of higher velocity the local velocity will decrease, meaning that a higher speed can be reached before a shock occurs. This effect is the reason for nose C, which is somewhat flatter just back of the front. The results of the tests with the wing at 0-deg. angle of attack (centerline horizontal) are given in Fig. 12 as the values C_{D_e} against velocity. The coefficient C_{D_e} is the total drag measured less the drag of the wing alone, that is to say, the effective nacelle drag. In these tests the conductivity was about $K = 0.085$ and $\Delta p/q$ was 0.22 for nose 2; 0.29 for nose 7; and 0.20 for nose C. Nose C is seen to have the lowest drag and nose 7 and 2 higher. Nose 7 would have had about 5 per cent lower drag had the skirt been altered to maintain the same pressure drop. There is some increase of the coefficients at the lower speeds due to a Reynolds number effect, and no great change beyond 200 m.p.h. until the rapid rise at the shock speed. Nose C appears to have accomplished its purpose of raising the shock speed. Further increase is to no purpose because a shock wave appears on the wing and the limit is therefore about 475 m.p.h. The cowling is thus proved to be adequate for conditions not likely to arise for some time to come.

These results give some information on nacelle-wing interference. A comparison of the nacelle drags in Fig. 12 with the drag of the nacelle alone in Fig. 2, at the same $\Delta p/q$, indicates that there is a favorable interference drag of about 45 per cent. This value is in close agreement with the value obtained in earlier tests[8] for the same relative nacelle diameter and wing thickness. The older tests were made on a model simulating an engine without baffles. Apparently the higher velocity of the air out the exit has a very small effect, as is to be expected considering the fact that the internal air is a small part of the total nacelle flow area and a much smaller part of the flow area influencing the wing. With larger wings and, hence relatively smaller nacelles, the interference becomes much more favorable; and the added drag due to engine nacelles may become 5 per cent, or less, of the total drag. "In-the-wing" engines and

[7] See *Journal of the Aeronautical Sciences*, September, 1937, pp. 448-452: "Cooling of a Radial Engine in Flight," by Oscar W. Schey and Benjamin Pinkel.

[8] See N.A.C.A. Technical Reports Nos. 415 and 462, 1932 and 1933: "Tests of Nacelle-Propeller Combinations in Various Positions with Reference to Wings; Part I. Thick Wing – N.A.C.A. Cowled Nacelle-Tractor Propeller; III. Clark Y Wing – Various Radial-Engine Cowlings – Tractor Propeller," by Donald H. Wood.

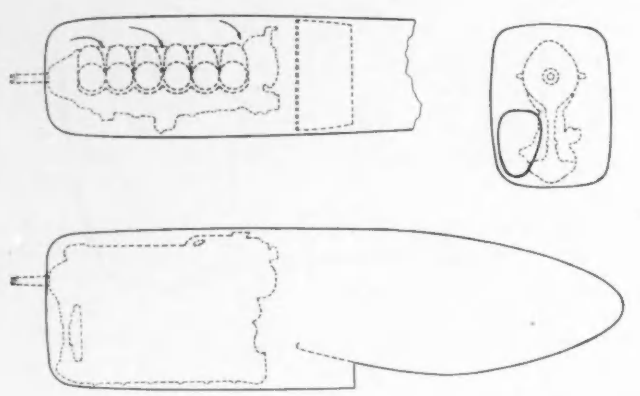


Fig. 13 – In-Line Engine Cowling – Small Opening

other types are likely to have strong competition from the cowled radial-engine nacelle for some time.

The In-Line Engine

A second type of air-cooled engine with cylinders arranged in a line parallel to the crankshaft has been made in considerable numbers, and its cowling and cooling problems merit attention. Unfortunately work on this type has not been very extensive, and it is not possible to treat it in much detail. The following remarks, largely quantitative, may be of some value.

The in-line engine is constructed commonly with 4 or 6 cylinders in one line, or bank, or 8 or 12 cylinders in two banks with a single crankshaft. An H type with two crankshafts recently has been brought out. The fact that the cylinders are arranged one behind another theoretically allows a cowling to be placed around the engine with a much smaller cross-section than for a radial engine of the same displacement. This construction represents a fundamental difference between the two types as regards the cooling mechanism, whereas the cowling presents the attractive possibility that the drag can be reduced because of the reduced nacelle cross-sectional area. Whether this condition is true or not is not yet conclusively established because most of the in-line engines have been of low power and there have been few radial engines in the same power class. Data are not available on the latest in-line engines of higher power. It is also clear, from the discussion of the radial engine, that the drag cannot be based purely on the relative cross-sectional areas but the effects of the entrance and exit, and of the internal air flow must be included.

It is the fundamental difference in the internal flow that requires detailed examination. In the radial engine the air enters at a low velocity due to the large opening and flows around all the cylinders in the same way. In the in-line engine the front opening is necessarily smaller, because the whole cross-section of the cowling is no longer greater than the sum of the projected frontal area of all the cylinders but rather is only a few times the frontal area of one cylinder. Furthermore, the opening cannot be made to cover nearly all of the frontal area as in the radial engine because the air cannot flow along both sides of the cylinders at once and provide proper cooling.

In the radial-engine cowling the area of the front opening is normally about 75 per cent of the cross-sectional area. In typical in-line engine cowlings the front opening is about 12 to 15 per cent of the cross-sectional area. The total cross-section again being only about 70 per cent of that of a radial-engine cowling of the same power, the velocity through the front opening of the in-line engine cowling is about $\frac{0.75}{0.12 \times 0.70}$ = 8.9 times that through the radial-engine cowling; and, were it not for the fact that the air column enters the radial-engine cowling at very low velocities, impossibly high velocities would be required in the in-line engine cowling entrance. In fact, with the ratios of areas given, the air must pass through the opening at nearly free-air velocity. With engines of high power, a greater relative opening may be required. The relative cross-sectional area is diminishing and the large opening may not be possible without other alterations.

A cowling of the type just discussed is illustrated in Fig. 13. Note the small opening and its location. This arrangement was applied to an engine of 145 hp. It was intended to be representative of a number of observed installations. The cross-sectional area was 5.1 sq. ft., and the entrance opening was 90 sq. in. The engine just cooled at an output of 80 hp. at 100 m.p.h., and there was a wide difference in the temperatures of the different cylinders. The drag coefficients were $C_D = 0.267$ with the exit closed and $C_D = 0.301$ with the cowling in operating condition as illustrated. Smoke-flow studies revealed a breaking away of the flow at the corners of the front of the cowl and, despite a careful rounding of edges of the entrance opening, the flow broke away there also.

Internal-pressure measurements revealed another important fact. The air, after entering the opening, did not slow down but rushed along the side of the cylinders and, in its unguided turning, lost 30 to 40 per cent of its available head before it reached the cylinder baffle system. The head available for overcoming the resistance of the latter thus was reduced greatly, and a much larger exit conductivity was required to get the necessary cooling air through. This condition was aggravated further by a conductivity of $K = 0.08$ resulting from the rather coarse cylinder finning of the low-powered engine. Altogether, this cowling exhibited about all the undesirable features of an engine cowling.

The most obvious remedy seemed to be to increase the area of the entrance opening and provide a large space on the entering side of the cylinders for the air to slow down in and, thereby, lose so much of its kinetic energy that little would remain to be lost in turning toward the cylinders. To eliminate breakaway at the outside the front was shaped like one of the successful radial-engine noses. The cross-section was made circular, and a large opening was provided.

This nacelle is illustrated in Fig. 14. The cross-sectional area is 6.53 sq. ft. compared with 5.1 sq. ft. for the first example and the entrance opening is 201 sq. in. compared with 90 sq. in. The cross-sectional area is, therefore, 28 per cent larger and the opening area 124 per cent larger. A greater rounding of the front would have been desirable but, in the engine available, the distance from the front of the camshaft housing to the propeller was too short to permit it. It may be remarked that some manufacturers have expressed concern about the propeller efficiencies with the propeller close to the engine. The propeller efficiency is slightly better than with a radial engine but it would be well to lengthen the shaft, forward, for the sake of a better cowling shape.

Another solution may be to use an elliptical cowling cross-section and internal guides for turning the air. No advantage can be seen for the small opening which would again be required, and there is likely to be some turning loss. The small cross-section will be helpful, however. A cowl of this type is proposed as a third step in a study now being made in the N.A.C.A. laboratories.

The cowling shown in Fig. 14 had a drag coefficient of

$C_D = 0.184$ with the exit closed compared with $C_D = 0.1115$ for the radial-engine cowl similarly closed, that is, 65 per cent higher. This result may be due, in part, to the higher fineness ratio but must be largely an effect of shape. With the cowling operating with $\Delta p/q = 0.86$ and $K = 0.052$ the drag coefficient is $C_D = 0.211$, which is only about 10 per cent higher than a radial-engine cowling ($C_D = 0.18$) operating under the same conditions. The turning loss is eliminated and temperatures are quite uniform among the different cylinders. There is apparently some large restoring effect operating to reduce the drag due to external flow so much. This condition is also characteristic of the first nacelle, as will be seen from the drag figures given for it, although the total drag is much greater.

A 550-hp. engine in the radial-engine cowling of 14.7 sq. ft. area develops 37.4 hp. per sq. ft. of nacelle frontal area, whereas the 145-hp. engine in the 6.53 sq. ft. area in-line engine cowling develops about 22.2 hp. per sq. ft. of frontal area. With the first cowling (Fig. 13) the value is 28.4 hp. per sq. ft. and, for the proposed elliptical cowl, 28.2 hp. per sq. ft. A typical 145-hp. radial engine develops 19.9 hp. per sq. ft. of nacelle cross-sectional area. The latest 1500-hp. radial engines of 56-in. diameter have 87.5 hp. per sq. ft. An H type in-line engine which probably develops the most power per cubic inch displacement of any of this type has about 152 hp. per sq. ft. This value is probably quite optimistic, however. These values show that the frontal area per horsepower varies widely. The advantage of reduced cross-section of the in-line engine is not apparent except at highest powers that have yet been developed in this type, and this advantage has not been proved. At low powers the in-line engine shows no advantage, over the radial engine, in lower drag.

The foregoing remarks on the in-line engine show that the problem is quite different in detail from that of the radial engine. The experiment using a larger opening and larger cross-section at entrance improved conditions but it is not necessarily the best solution. There is, however, an advantage in the reduced velocities at the entrance that it is hard to down, and it is difficult to see how the desired results can be obtained otherwise. A greater portion of the work on in-line engines has been with engines of low horsepower, and there has never been any acute cooling problem with any type of engine until fairly high powers have been attempted. The in-line engine must pass through this same trial on its way up but, if the fundamental factors involved are recognized, perhaps some troubles can be avoided. The studies now in progress should provide much useful information, and I am sorry that I cannot present as complete a solution for the in-line engine as for the radial at this time.

Future Work

In the type-testing of engines enormous power can be, and usually is, put into the auxiliary blower or the club propeller is constructed to blow an unduly large volume of air over the engine. Such tests establish the reliability of the engine, if cooled, but are of little use in determining whether the required cooling can be obtained efficiently in an actual installation. It has been noted that many of the more recent engine test stands are, in effect, wind tunnels. It would seem, then, that the engine under test could be surrounded with some standard form of cowling with suitable skirt adjustments and fitted with the recommended baffles. The pressure drop, the quantity of air, and the conductivity could be determined and supplied with the power data to the airplane designer, who could then lay out a cowling with some certainty that it would enable the engine to function as intended.

A great deal of useful work also could be done in fin and

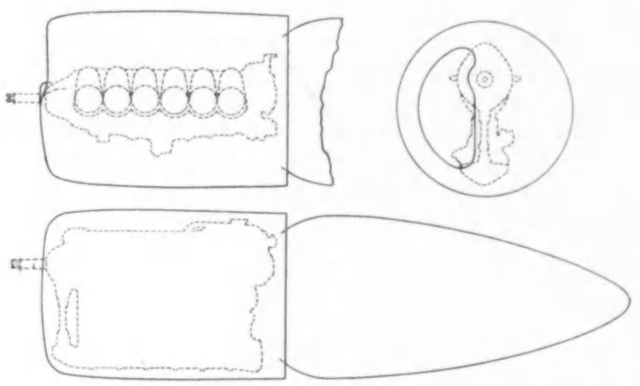


Fig. 14 – In-Line Engine Cowling – Large Opening

baffle design without the disturbing effects of single-cylinder engines operating in an environment foreign to that of the later installation in a complete engine.

In other words, the more nearly the development and type-testing approaches the actual conditions encountered in the final application, the more nearly will the solution meet those conditions and, quite likely, with less total labor in the process. The design and application of airplane engines, as indeed all parts of the airplane, have become a complicated engineering problem. As the cowling has become an important part of the engine application, a more intensive engineering outlook on it will not be amiss. The foregoing suggestion is made in that light.

In addition to improved methods of testing to determine engineering data and further study of cylinder fin and baffle cooling, some new experimental work on wing-nacelle interference is necessary. Nacelle interferences previously determined have been measured for nacelles that allowed a large internal air flow and the nacelles were large compared to the wing thickness. Although it does not appear likely that the internal flow can cause a very great effect, the question should be studied. The question of relative nacelle size is of great importance because indications point to a considerably reduced nacelle drag with the larger airplanes in prospect. It may be noted that steps are being taken to answer these questions.

This information will be of value in comparing with other proposed and existing types of installation, both air-cooled and liquid-cooled. Designers are pondering constantly the relative merits of different types, but as yet the deductions are not conclusive. For example, it has been stated that installing the engine in the wing and driving the propeller through a shaft reduces the drag to practically zero. This result, however, excludes the cooling drag. It is not certain that the cooling drag can be reduced to the very low value required by the radial engine. In fact, it may not be necessary to reduce it that low for an equal or better overall result. More experimental work is required to get the answer to this question and, until some conclusive results are available on the cooling drag of these types, an intensive development of the new engine types that may be required can not be expected. How soon it will occur or whether or not it will occur at all will depend on how impressive the results are.

The radial engine possessing, as it does, so many advantages, both inherent and acquired through development, looms large as a competitor for any other type. It must not be assumed that the manufacturers are wedded to it for life, however; and, if other forms show great promise, they will be developed. This

fact is true, in part, for the in-line engines and also accounts for the survival and continual improvement of the liquid-cooled engine. For the sake of progress, the experiments on cooling and cowling should be prosecuted intensively. It is to be hoped that, in the rush for an answer, the fundamental questions involved will not be neglected for, without a rational method, the design becomes a hodge-podge and guess follows guess. If this paper is read only as an illustration of a design method, it will have served its purpose.

Discussion

Reviews Progress in Fin Design

– Oscar W. Schey
Mechanical Engineer, National Advisory Committee for Aeronautics

During the last few years fin proportions have been investigated extensively considering such factors as spacing, width, thickness when using blower cooling, and when cooling in a free air stream with and without baffles. These tests for each condition were conducted over a wide range of air velocities. To obtain information on the conductivity factor steel, aluminum, and copper cylinders have been used. Fig. *A* is a sample of results obtained on one of the many cylinders tested. These curves show that the optimum fin spacing is the same regardless of the method of cooling used. The curves for blower cooling show that the heat transfer per inch of cylinder wall area decreases as the fin space is reduced to less than 0.045 in. even though the velocity between the fins remains constant, showing that the nature of flow or the flow pattern is not as conducive to good cooling when the space is less than about 0.045 in.

The curves for blower cooling show that the heat-transfer coefficient is not sensitive to the number of fins per inch on either side of the maximum for, with 11 to 16 fins per in., the heat transfer is 95 per cent of the maximum value. In the September issue of the S.A.E. Journal is published a paper by Arnold E. Biermann showing the optimum fin spacing on a pressure-drop basis. His results showed that the heat-transfer coefficient per square inch of wall area was not sensitive to the fin spacing over a wide range of fin spacings for constant pressure drop across the cylinder. For a constant pressure drop the flow between the fins decreased when the fin spacing was decreased so that the gain from increased cooling area was offset by reduced flow between the fins. That the flow between fins is very sensitive to the spacing within this range may be appreciated from information recently published by Rollin and Ellerbrock as Technical Note No. 621 of National Advisory Committee for Aeronautics. The researches of these men are in full agreement, and a study of their work is recommended. We must, however, bear in mind that, in selecting fins of optimum proportions, many factors must be considered as quantity of cooling air, pressure drop across the cylinder, energy required, and the weight of material, are all important factors.

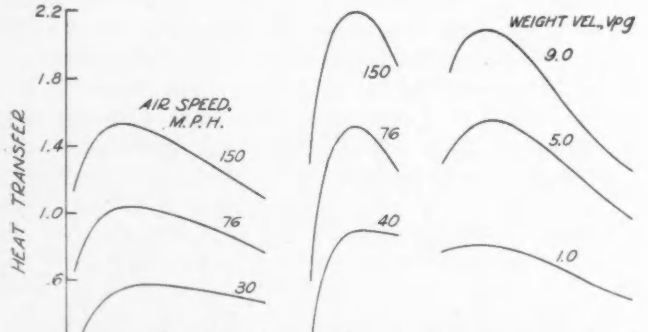


Fig. *A* (Schey Discussion) – Variation of Heat Transfer With Space Between Fins

The writer, however, has a strong opinion that the fin proportions requiring minimum energy to force the air past the cylinders will be best from a consideration of all factors involved, especially when we consider that the quantity should be limited to that required to cool the engine satisfactorily in order to reduce the drag to the minimum.

Tests on these finned cylinders using blower cooling also have shown that the finning that gives the best cooling also requires the least expenditure in energy in cooling.

Sufficient information has been published on optimum fin spacing in the form of reports, notes and publications of this Society so that without difficulty one could design finning which would enable at least a 50 per cent increase in power. The problem is no longer the determination of the best finning. The problem now is to develop some practical method for constructing cylinder-heads having from 10 to 13 fins of 2-in. depth per in.

In discussing the problem of baffles the following conclusion taken from an N.A.C.A. report of several years ago has been substantiated further: "Optimum cooling was obtained with shell baffles when they were mounted as closely to the cylinder as possible, when the entrance was equal to the arc subtended by an angle of approximately 145 deg. when the rearward extensions were 3 in. or more long and when the ratio of exit area to free-flow area between fins was between 1.6 and 2.3." These tests were conducted with baffles having an arc of 1⅛-in. radius forming curves where rearward extension joins to the baffle. A test conducted since shows that this radius gives practically minimum loss in the rear. The pressure drop across a baffle having a ⅛-in. radius at exit of baffle is about twice that of baffle having a 1⅛-in. radius. The report from which I have quoted contained a few tests on baffles made integral with the fins. With integral baffles the rear wall temperature was reduced from 298 deg. fahr. to 203 deg. fahr. and the heat-transfer coefficient increased from 0.0965 to 0.1488 as compared with a cylinder without baffles. The improvement with this integral baffle was no doubt due to the increased cooling area. Baffles made integral with the fins serve a two-fold purpose in that they increase the cooling area and also direct the cooling air. With this baffle arrangement, fins of less thickness could be used as the baffle would form a protecting shield.

As future work I suggest a study be made of cooling and drag for different engine location and arrangement of cylinders. In conjunction with this work the cooling drag at high speeds should be investigated in order to determine whether or not it is practical to use a blower at high speeds and how much reduction in cooling drag, if any, can be obtained by use of a blower. If a blower is to be used, the most favorable location of openings for inlet and exit of cooling air should be studied.

The author has characteristically added much common sense to the problem of cowling of engines, and has presented a paper that will be of considerable value.

Explains Differences with Author's Conclusions

– Benjamin Pinkel
Assistant Physicist, National Advisory Committee for Aeronautics

In general the discussion of the aerodynamics of the cowling is well presented. There are a few points which are not clear. Under "Analysis of Drag Components," it is stated that, for a K of 0.06, a $\Delta p/q$ of 0.666 is required in climb as compared with a value of $\Delta p/q$ of 0.367 at K of 0.04. It would appear that the quantity of air required for cooling a given engine would be very nearly proportional to the conductivity. Referring to Equation 3, it then appears that $\Delta p/q$ should not be expected to differ very greatly for the two conductivities.

In presenting Equation 8 in connection with calculating skirt exit areas Mr. Wood states that there is an increase in total pressure drop across the cowling with increased flow through the cowling. Further discussion of this point is necessary since it would appear that the increased flow caused by increasing the cowling exit area would tend to neutralize the negative pressure in the external air stream adjacent to the cowling exit and would result, if anything, in a slight reduction in total pressure drop.

Discussing future work at the conclusion of his paper, the author states that it is not certain that the cooling drag of liquid-cooled engines can be reduced to the very low figure required by radial engines. The cooling drag power of a cooling system decreases as the surface available for cooling is increased and the cooling air velocity decreased. The liquid-cooled engines have the advantage that the cooling area can be increased without restriction other than that imposed by weight and space, whereas there is a limit to the number and size of fins which can at present be constructed on an air-cooled engine. This advantage always has been conceded to the liquid-cooled engines, and it is up to air-cooled engines to show that their cooling drag power can be reduced to approach that of the liquid-cooled engines especially for engines of high specific output.

Additional Test Results on Pressure Drop

–Herman H. Ellerbrock, Jr.

Assistant Mechanical Engineer, National Advisory Committee for Aeronautics

IN Fig. 9 of Mr. Wood's paper the pressure drop has been plotted against angle around the cylinder. Points have been placed on the curves at 0 deg., 90 deg., 135 deg., and 180 deg., and it is to be supposed that pitot tubes were placed only at these points. A few total head curves have come to the attention of the writer where more pitot tubes were used. The shape of the curves from the 135-deg. point to the 180-deg. point was much different and there was an indication that a greater loss occurred between the fins before the air entered the exit. A further study of the pressure drop around the cylinder seems to be needed.

In connection with the loss occurring due to mixing of the two air streams at the back of a cylinder, tests[a] have been made in which the radius of the fillet joining the skirt of the baffle with the baffle proper was varied from a sharp edge to 1½ in. in ¼-in. increments. Such an increase in the radius reduced the pressure drop across the cylinder approximately a half of what it was with the sharp edge.

Mr. Wood has shown that the power required for cooling, based on his criterion, is very low when controllable cooling is used. In discussing the losses around the baffle he points out that, if all the losses in the exit were recoverable, the energy required for cooling would be about one-third of what it is normally. As the power required for cooling is already very low, it does not seem that the added complication of an expanding passage on a baffle would be justifiable if the energy gained was the only factor. The important factor that needs be mentioned is that, with a good baffle design and a greater pressure drop available across the cylinder for cooling, an appreciable increase in engine horsepower could be obtained. Equations developed[b] for the heat-transfer processes in engines show that the horsepower that can be dissipated varies directly as the mass flow of air through the baffle which, in turn, increases as the pressure drop across the cylinder increases. Mr. Wood has pointed out that, if all the energy lost in the exit were recoverable, the pressure drop required would be one-third of what it would be with the poor exit design.

Mr. Wood's point on the necessity for tests to settle the controversy on engines in the wing or on the wing is well taken. Such tests seem to be an absolute necessity if progress in the right direction is to be made.

[a] See N.A.C.A. Technical Note to be published: "Pressure Drop Across Finned Cylinders Enclosed in a Jacket," by Vern G. Rollin and Herman H. Ellerbrock, Jr.

[b] See *Journal of the Aeronautical Sciences*, August, 1937, pp. 403-410: "Heat-Transfer Processes in Air-Cooled Engines," by Benjamin Pinkel.

The Body Designer's Future

By John Oswald

Chief Body Engineer, Olds Motor Works

THE forerunner of the present-day body designer was the old-time carriage builder. He was a craftsman of the first order, and we all know of the beauty and artistry of his creations. With the advent of the automobile as a means of conveyance, attempt was made to adapt the carriage to automotive use. Some of the results were crude but, in those early days, the foremost consideration was not beauty and styling, but "Would it run?" For many years body development was subordinate to mechanical development, the body consisting primarily of a covering for the car's mechanism and a place for driver and passengers to sit.

As the mobile parts of the car were improved and perfected, more thought was given to the appearance and riding qualities of the car.

A few years before the World War we had never heard of a body engineer. He usually was classified as a body draftsman, and his jurisdiction was limited greatly. By that sentence I mean that any part of the car forward from the dash was out of his control. He merely saw that the body was located in the proper position on the frame and that the wheelhouse was approximately in the right location. The sheet metal, such as rear fenders, front fenders, hood, radiator shell, and running boards, were controlled by the chassis engineer and designed by sheet-metal draftsmen. The foreman in the trim shop determined the shape and style of the trimming, and the paint-shop foreman decided, with the management, the colors for the cars. There was little coordination among the different departments, and we can all remember some of the atrocities committed in the name of engineering and styling.

As body development and styling assumed greater importance, these various activities were grouped in one department, and the body engineer was given charge. He also was given more liberties in the appearance of the car as well as more responsibility in the actual design.

[This paper was presented at the Detroit Section Meeting of the Society, Detroit, Mich., Oct. 18, 1937.]

The present-day body designer and engineer has even more liberty and responsibility. Today he not only develops the design and style features, but he must also satisfy the requirements of the manufacturing division to produce the unit at the lowest possible cost. He must make careful selection of colors, trim, and other accessories which are necessary to the complete equipment of the car, and adapt all these features to the chassis design to produce a unified and beautiful ensemble.

I believe that today the body designer has come fully into his own. With each added responsibility his field has been broadened until, at the present time, his division of the work has attained equal importance with that of the chassis.

Thus we see how far the body designer, as an individual, has progressed, along with the improvement of his product. But, beautiful and perfect as the present-day automobile body seems to us, improvement has by no means become stabilized, nor has progress become static. As the future of the body designer and engineer is related so closely to the product, in order to predict his future we must acquaint ourselves with modern trends in design.

Right here let me emphasize that, regardless of what the style or construction of the future automobile may be, first and foremost the car buyer and his requirements must be considered. He has come to expect a great deal in the way of riding comfort, refinements, roominess, ease of access and control, and these things must not be sacrificed to accommodate the mechanical features of the car.

The interior of an automobile should be in keeping with the modern living room, where the user can relax, and operating a car should prove just as comfortable and enjoyable as sitting in an easy chair at home.

There is a present tendency to encroach on body roominess by tunneling, and because of the large space necessary for chassis units such as engines, transmissions, and rear axles, as well as the addition of equipment and accessories such as heaters and radios. These are all necessary adjuncts of the modern car and space must be provided for them but, so far,

it has been done largely at a sacrifice of roominess and accessibility for the user.

The rear-engine-drive car, although it has not gained much headway in this country, appears to have many advantages over our present front-engine car, and may prove a solution to some of the problems of the body engineer. This possibility is rather remote at the present time, however, and the rear-engine car cannot become an actuality as long as we must use our present type of engines, axles, transmissions, and driving mechanism and accommodate them to the wheelbases which we have come to accept as standard in motor-car design. These are problems for the chassis engineer and, until they have been worked out satisfactorily, we cannot expect much radical change in body design.

Another pertinent question in motor-car design today, which is probably much nearer realization, is that of the unit type of construction as against our present type of construction, that is, the frame and chassis as a separate unit from the body. Just because our present type of construction has been in use for many years does not necessarily mean that it is entirely outmoded. Neither does the fact that the unit type of construction is new give it any advantage over the older type. It is quite obvious that the unit construction, whether it be for rear-engine, front-wheel drive, or standard-propelled design, is more expensive to build and service, with no advantage in economy of maintenance or manufacture. And with unit construction, there is the handicap of creating from year to year, style changes without exorbitant tool cost. With our present type of construction, keeping the frame and chassis an individual unit from the body, we derive a great deal more flexibility for making changes and improvements in appearance and manufacture, whether it be on the body, chassis, or both.

I, personally, do not believe that the buying public appreciates or cares whether we have a unit construction, or our present method of construction, as long as it gets a dependable, comfortable car.

Now, to get to the point of our title, how does all this affect "The Body Designer's Future"?

Obviously, if the present type of construction continues, the body designer and the chassis designer will have to cooperate to work out their difficulties and differences where their ideas conflict. The body designer's job will be much simpler, but by no means done. There is still much room for improvement in our present type of construction – I have yet to see the perfectly designed automobile – but the changes from year to year will be primarily for appearance and style, and for manufacturing economy.

On the other hand, if and when the unit type of construction does come, we must be prepared to meet it and accept the added responsibility of incorporating more and more structural units into the body. The body of the future car may eventually contain all of the principal members of the frame, and the dividing line between chassis and body will disappear, in which case the body designer will be responsible for a greater unit. If he can combine styling with sound engineering and practical, economical manufacture, there is no limit to the possibilities ahead for him. It may mean a reorganization of the whole structure of the motor-car industry as we are familiar with it today, both from the standpoint of the designing and manufacturing. The body- and chassis-engineering departments possibly may merge into one department, and manufacturing procedure will certainly be far different than it is today. Just what the position of the body engineer will be in this changed state depends only on the individual and what he does with his opportunities.

In conclusion, I am going to offer a suggestion which you may or may not take seriously. Whether we continue with our present type of construction, or go to some other, it is certain that the chassis designer and the body designer must get together and harmonize their ideas, subordinating the individual glory of star performance in the development of new work, to the greater benefit of the user and the steady advancement of the industry which, in turn, means greater glory for all. A balanced, well designed automobile is our aim, with neither the characteristics of the mechanical monster of the chassis engineer nor the vague fantasy of the stylist.

Let us respect the other man's ability, be he chief engineer, chassis engineer, body engineer, draftsman, tester, or tracer. Do our utmost to help solve the other fellow's problems, and I am sure that we can show more progress in future years than we have in the past. Let us not be too rigid with our own pet ideas, and give more thought to the man who buys the car, for he is the one who must live with it and maintain it.

Advantages of Stainless Steel for Aircraft

Stainless steel is already cheaper, pound for pound, than the lighter alloys, even though its use and production extend back but a relatively few years. This factor becomes of increasing importance as the refinements of production improve the relation between labor and material costs.

Stainless steel comes ready for use. Neither its strength nor its corrosion resistance depends upon heat or other special treatments. It is usually supplied in coiled strips which can be formed readily into required lengths and thus reduce scrap loss. The forming is done through rolls, which is more of a production operation than is hand- or power-brake folding.

Stainless is susceptible to adequate assembly by welding, either automatic for sub-assemblies or a hand operation for a major assembly. Neither requires especially trained operators. In the "Shotweld" process, the weld quality is governed automatically.

The normal corrosion resistance of stainless steel and the absence of aging must be accepted regardless of certain special instances which have been cited against it.

Permanence of material, however, becomes an increasingly important factor as the investment in air equipment increases and as types become so stabilized that obsolescence no longer determines the useful life of a plane.

Whether it be commercial competition or not matters little compared to the advantage of developing an industry which is not absolutely tied up to a single source of material. This brings us to the last point.

Availability. Although stainless is dependent upon both nickel and chromium, its processing is not the work of one concern alone, nor does it require elaborate and single-purpose plants. Electric furnaces and rolling mills are the usual equipment of the steel mill. There are today a dozen mills supplying stainless steel and the competition among them already has resulted in price and quality improvements.

Still another argument favoring higher availability of material lies in the fact that the tools, equipment and designs made for stainless steel are also available for use with any other alloys of steel.

Excerpts from the paper: "Engineering for Production in Stainless Steel," by E. J. W. Ragsdale, chief engineer, Railway Division, Edward G. Budd Mfg. Co., presented at the National Aircraft Production Meeting of the Society, Los Angeles, Calif., Oct. 7, 1937.

Looking at the Future of Car Design

Through 1937 Trends

By Norman G. Shidle
***Executive Editor*, SAE JOURNAL**

A FIRST step in trying to look at the future through current design trends is to find out the reasons behind the various design changes that the engineers already have been making from year to year.

It is no easy job to pin those reasons down.

Engineers start out to improve one feature of their design only to find sometimes that, having done so, they have created two new design problems which weren't there at all before. An engineer may improve 100 per cent the heat dissipating qualities of brakes as compared to his previous model, only to find that his body stylist has given him new styles in wheels and fenders which increase the heat *generating* qualities $99^{44}/_{100}$ per cent – so he has to start to hunt for net improvement all over again.

Unpleasant as such little surprises are, however, it can probably be said: "Of such is the kingdom of automotive engineering progress."

It is interesting to speculate, though, upon what the engineering departments of this industry might have thought of – might have brought to practical fruition – in the last 12 months if so goodly a proportion of their time and energies had not gone into devising and making applicable ways and means of getting the floor of the body 2 in. nearer to the ground than it had been heretofore.

Nevertheless, this lowering of floors, which has brought about definite changes in rear axles and propeller shafts for 1937, is one phase of a trend, in which 1937 models do mark a direct step toward the future – that is toward more room for passengers within the automobile body. Practically every maker in 1937 has greater interior height and width, while a good many have a little greater length – this latter achieved in more than one case by actually lengthening the wheelbase. There can be little doubt that these increased dimensions are being favorably received by the average car driver, particularly since he isn't paying any more for them than he did for smaller dimensions last year.

In the accomplishment of this greater all-around roominess, several of the other major design tendencies of the year developed more or less automatically. Near the top of this list, perhaps, we might place weight reduction of individual chassis parts. It seems a bit silly, maybe, to talk about weight reduction and fuel economy and about longer wheelbases, bigger bodies and increased engine sizes in the same breath. But that is just what has to be done in describing the 1937 models.

It is apparent that if car sizes were to go up in 1937 and prices remain approximately the same, weight of individual parts had to be reduced somehow – for the old price-per-pound problem stares the engineer right in the face whichever way he turns, particularly in a period when material costs have been rising rather than falling.

Features looking toward comfort which are common to a majority of the new cars include increased luggage space,

● Intimate talks with leading engineers and executives throughout the automobile industry were the foundation of this article's attempt to utilize 1937 automobile design trends as glasses through which to see probable future developments.

● "Some ideas in the discussion," Mr. Shidle said when presenting the paper before the Detroit and Canadian Sections recently, "are stated more positively than the facts may warrant solely in the interests of emphasis and in the hope of starting an argument."

● He predicts, among other things, that demand for more and more roominess inside the car body will be a most potent influence on design of many chassis and engine as well as body parts.

wider bodies, wider and higher door openings, easier operating transmissions and gearshifts and better radio reception through improved aerials.

Greater economy of operation is being stressed in these 1937 cars. Design features contributing to this result include more general use of overdrives and detailed improvement in the functioning of these units, an arresting of the trend toward higher top speeds, installation of completely new engines in several high production cars and a multitude of small, though very real, refinements in carburetion, manifolding and other elements of powerplant construction.

Further attention to safety and safe driving features is evident in the 1937 models. In this category perhaps may be listed devices for keeping windshields clear of frost and snow; driver seats which adjust vertically as well as horizontally; refinements in steering mechanisms; wider and higher windshields; detailed improvements in size and functioning of brakes; knobs and handles recessed into instrument panels; and outside door handles which curve in toward the body.

Defrosters Almost Universal

The defrosting equipment, which consists of warm air blown from the car heater through vents in the dashboard to the windshield, is almost universal on the American cars. This is a really important contribution to safe and comfortable winter driving for owners who buy a car heater.

Despite continued rumors to the contrary, there are not any automatic or semi-automatic transmissions on cars exhibited at the Fall Shows. Whether such units will make an appearance in production before 1938 remains a matter for conjecture.

Steel tops are *almost* universal on 1937 cars, as are hydraulic brakes. Both items are found on the product of *almost* every major producer. All-steel bodies from which wood has been entirely eliminated are *almost* but not quite universal.

Problems of bettering radio reception have occupied the serious attention of American designers again this year. Introduction of steel tops forced aerials from the roof to the running board with a resulting decrease in reception satisfaction. Improvement in this regard is found in 1937 models, but several makers are offering in addition as optional equipment special aerials fastened on the outside of the roof or fenders. This is being done because some owners have clearly showed that their desire for better reception is quite strong enough to make them seek it even at the expense of attaching none-too-sightly equipment to the outsides of their cars.

"As long as business is good, our major producers are much more likely to continue improving products which they know are selling than to embark on the uncharted seas of totally new design concepts."

There is much change but little that is radically different in appearance of the 1937 models. The tendency toward simplicity in exteriors and reduction of shining, plated gadgets has been further extended in the new models, with some exceptions to prove the rule. A majority of makes present an appearance for 1937 clearly different from their own 1936 aspect, but nothing unique appears. Louvres have been changed, frontal appearances altered and modifications made in body contours – but bizarre shapes are absent.

The continuation of excellent sales throughout the industry undoubtedly is largely responsible for the conservatism of design movement at this time.

There is a tendency on the part of those who would like to see more rapid and startling changes to summarize these design achievements in the form of an implied criticism – "All they've done this year is to refine some more."

As a matter of fact, in view of the economic and business soundness of the course which is being pursued, one might better say: "They've even found new refinements possible again this year," expressing an implied admiration for the ability of our engineers to further refine units upon which careful, painstaking design, research and testing effort have been going on for anywhere from 5 to 25 years. Doing that kind of job sometimes requires more ingenuity than would a complete rearrangement of units and structures – a starting-all-over-again.

The results of this very refining process, in fact, carry in themselves the best reasons which can be given against a complete rearrangement and redesign of major units at any one time. Every unit on the automobile today has the same *name* that it had many years ago; but it's an entirely different unit. The water pump of today is nothing like the water pump of 10 years ago, yet it still is a water pump and it performs the same function – but more reliably, more effectively and more cheaply. A 1930 engine might have had the same bore and stroke and number of cylinders as a 1937 engine; but, if the 1930 engine gave 80 hp. and 160 ft-lb. of torque, the chances are the 1937 one will give something like 115 hp. and over 200 ft-lb. of torque. So with almost every other part in the car – each one is the result of years of consistent and persistent betterment.

Effects of Sudden Change

If we were suddenly to drop the engine in the rear or make equally violent rearrangement of our present automobile structure, there would be some loss in reliability and refinement on some units – just how much is hard to say. Some engineers say we would throw immediate design efficiencies back anywhere from 5 to 10 years on perhaps 25 per cent of the parts of the car; others think the sacrifice would be much less; a few that the parts of a rear and a front-engine job including the body can be made 97 per cent exactly the same if somebody puts his mind to it.

Wherever the percentage lies, most car company engineers feel that there would be a measurable penalty. And it is idle, they point out, to say: "Why don't engineers make every part the very best way the first time they design it – particularly when they understand the principles just as well in the beginning as in the end?"

The human mind and human organizations just don't work that way.

Only in mythology does Minerva spring full-grown in glittering armor from the brain of Jove and Venus rise from the waves, her beauty matured in adult birth.

Some will argue with considerable logic that the overall gains which might result from major changes would more than offset any possible temporary retrogression as regards refinement of details. But, without entering that particular

argument – because it has been pretty thoroughly thrashed out before SAE audiences on several occasions within the past year – I would say that there is no strong leaning toward rear-engined cars among quantity producers today; and that only a marked change in our economic picture or unexpected action by some one of the major companies is likely to change that situation in the next year or two.

Steady Improvement Policy

As long as business is good, our major producers are much more likely to continue improving products which they know are selling than to embark on the uncharted seas of totally new design concepts. The same thing is true to all intents and purposes of our successful companies of middle size. The argument that they *must* do something different to compete successfully against the quantity-produced cars of the Big Three, must be taken with several grains of salt by anybody who wants to be intensely practical. Putting it bluntly, these middle-sized companies can even less afford to make a major mistake than can any one of the Big Three. And when we turn to the really small production companies of the industry and examine the argument that they have everything to gain and nothing to lose by radical innovations, we must face that fact that it takes money – a very great deal of money – to do a radical job of engineering – getting into production – and merchandising successfully a product whose construction contradicts all the ideas being promoted and sold by the industry as a whole.

I don't think we can blink the fact that economics dominate and will continue to dominate the automotive picture in America. We will get sudden changes in design when we get sudden changes in economics. A radical move by one major producer could bring that change in economics to the automobile industry very fast; otherwise, the industry seems likely to move slowly but steadily in accord with the rather *viscous* flow of general economic change and public demand.

This probability is somewhat confirmed by an interesting theory which one of my most inspiring friends expounded to me several years back – and embellished a little more recently. The theory is that the mechanisms in any country are a reflection of the economics of that country.

Take the cars of the different vehicle-producing countries. Line up the German cars and most of them will look like German cars – in about the proportion that a group of Germans will look like Germans, even though a few look like Americans. The same way with the French and British and American cars. Each reflects the economics of the country in which and for which they are produced.

But . . . look at the twin-engine bombing planes developed for military purposes by these same countries. They all look very much alike. There are no economics involved in the operation of a war airplane. Each country has designed simply to make the plane perform its ultimate purpose most effectively without regard to cost of construction, operation or upkeep. The result is a considerable sameness – because engineering principles are the same everywhere. But the automobiles are different, because they are built to fit economic conditions, and economic conditions differ from country to country.

There may be some flaws in this theory, but it is worth attention as the basis for some very interesting speculation in general and about probable American automotive trends in particular.

Any extended discussion of the "economy" car in America would be out of place here, because that subject, too, has been labored so extensively in the last year or two that few arguments could be presented which are not more than familiar to every SAE member. Suffice it to say that there is no indication that a car with less comfort and less performance than our lowest-priced quantity production cars will meet with major success in America unless gasoline prices get very much higher or legislative restrictions on speed force smaller engines into the picture.

That doesn't mean, however, that economy isn't of any interest to our American motorists and engineers. In fact, the attempt to get improved economy *without* a decrease in performance or comfort characteristics seems to rate at the top of the list in engineering interest alongside of revisions to permit more and more roominess inside the body.

"Economics dominate and will continue to dominate the automotive picture in America. We will get sudden changes in design when we get sudden changes in economics."

The fight for these difficult combinations of qualities is responsible for the growing popularity of the overdrive in one form or another; for a certain amount of interest in supercharger possibilities; for intensive study of every detail of carburetion and manifolding; for examination of all possible means of reducing friction in moving parts; and for the very intensive study of weight reduction possibilities previously mentioned.

The most striking of engineering changes to come within the next five years, it seems probable, are likely to be the result of this ever-constant demand for more and more room and comfort inside the car body. With few exceptions both engineers and executives agree that this demand will continue. In order to accommodate it, various parts of the car will be changed – in minor ways as long as possible – in major ways when the end of the refinement road has been reached. We have already seen how 1937 trends point in this direction.

Moving the engine to the rear might solve this problem at one fell swoop – and, in the minds of many independent engineers, that is the way it should be done. As explained previously, however, it looks as though, so far as quantity production is concerned, many other moves are likely to be made before this expedient is put to the foreground.

Possible Engine Trends

Continued improvement in engine efficiencies will help. We can assume, I believe, that for all practical purposes we have reached the limit of average top speeds. Further horsepower-per-pound improvements in standard engines, therefore, may be expected to be reflected in smaller and shorter engines – which would help to give more interior body space without increasing wheelbase. This same demand points toward increased interest in V-engines, perhaps in X-type constructions and even toward the practical possibility of radial type engines in passenger cars within a few years.

The radial engine is old in principle, of course, has had tremendous success in the aircraft field and it would be surprising if it were not already the subject at least of serious research and experimentation in many parts of the automobile

industry looking toward the future demand for roomier interiors as time goes on.

Orderly Disorder

The practical technical aims of our engineering today cannot be expressed as a clean-cut, entirely logical, 1-2-3-sort of picture except in most generalized terms. The aims are interlocking, full of compromise and sometimes wavering for the very reason that they *are* practical. One might even say that they are confused because they are practical – and practical because they are confused.

Every engineer knows that it is easy to build into a car almost any exaggerated characteristic along any line, but that, beyond a certain point, no single characteristic can be built into a car except at the expense of something else.

It is the search for the best compromise at a given price each year that makes current trends and aims always seem a bit confused – although they are quite clear when the constant necessity for compromise is recognized.

– And compromise is necessary.

Yet courageous, aggressive, forward thinking on the part of engineers is essential if compromise is not to become sterility; if sane conservatism is not to become motionless impotence.

Because the best "refiner" may be the most useful member of today's engineering department, too many – of the younger men particularly – may be satisfied to confine their thinking solely to the details upon which their daily work necessarily must concentrate.

It isn't *fair,* in fact, to talk entirely about what engineers are doing to design. It's important to talk about what design may be doing to engineers. We may be doing an economically sound engineering job, but I think it must be admitted that as individuals some of us stand a good chance of gradually drying up mentally by too great concentration on refinement of work already pretty well polished by the roll of the years.

Engineers *need* to get the "feel" of how and why their customers think. That goes for the highest men in the engineering departments even more than for the lowest ones. An engineer would be crazy to take an owner's word for how he should design an automobile; but it's just as crazy not to know first hand what that owner wants, how he thinks, his judgment of relative values. Every year – and this year is no exception – new models are a measure of the selling as well as the technical ability of our automotive engineers.

As a matter of fact, one could describe the future of car design much more accurately if he could read the minds of the engineers as readily as he can read their blueprints.

SAE Values

– And the mind is bound to be sharpened by contact with generalized engineering thinking and discussion. Obviously, active association with the SAE provides one of the best chances for doing this particular thing. Ralph Teetor said recently that, "The SAE moves forward constantly on many fronts. Frequently the value of those movements to the individual member is limited only by the keenness of his own intellectual curiosity." That thought is worthy of profound meditation.

The future of design will depend heavily, also, on the degree to which engineers become more effectively articulate. What they think is one thing. What they are able to convey to somebody else is another.

It's worth while to know how to write and talk with the objective of interesting or convincing somebody who has a totally different background both of information and emotions and judgment of relative values.

This matter of being articulate, however, does lead us to what may turn out to be one of the most acute problems our industry has to face – better correlation of the efforts of advertising and sales with the realities of engineering achievement.

Real engineering achievement is definitely going along the lines of refinement, as has been brought out previously. As this process of refinement becomes more and more dominant, our advertising tends to talk less and less about the real improvements in our cars and more and more about easy-to-dramatize, but superficial appendages which have been added – "white rabbits" the engineers call them. These appendages, while frequently of very real interest and value to the car owner, do not *even symbolize* the actual improvements which have been provided for him. And yet, the advertising man is in a dilemma. Either he must dramatize these specific items or turn to generalities which so frequently fail to differentiate the car about which he is talking from its competitors. He needs *constructive* help from the engineer.

Eventually we may need a totally new technique of automobile advertising if our copy is not finally to be divorced entirely from the useful but undramatic realities of refinement which constitute the honest progress that has been made.

The Automobile's Contribution

Reading Alvan Macauley's recent speech to the New York *Herald-Tribune* Women's Forum, one was impressed all over again with the number of appeals which the automobile has for the average owner – appeals which might be especially effective in bringing entirely new buyers into the market. Mr. Macauley recalled the way in which the automobile has promoted health by permitting factories to be built away from congested centers, by giving both city and country families the means of enjoying the outdoors and fresh air. He said that the modern women are "shoppers on wheels"; that travel, the essence of culture, has been made available to the average man and that "if there ever existed a material aid to the abundant life, it is the automobile."

These appeals – as old as the automobile itself – still contain the essence of the average man's and woman's conception of his car. In so far as a new car bids fair to give him these things in greater abundance than his old one, so far will he be interested in a new one.

In a practical sense, this means – probably – more intensive study by engineers of conditions of normal, everyday automobile use and more detailed consideration of the problems involved in fitting design trends to those altering conditions. And, on the part of the general executives of the industry, a continuance and acceleration of the cooperative work with public and quasi-public agencies which they are already pursuing so vigorously.

In conclusion, it is fair to say that the engineers of this industry have done an extremely sound, aggressive and economic job in the last 12 months – a job of which they may well be proud; a job in which the youngest draftsman as well as the ranking executive in the engineering department has played a vital part; a job possible only through coordinated team play under well-administered direction, fortified by clear understanding of business and economic needs as well as of technical necessities.

They are to be congratulated on the products which they – with the help of the parts manufacturers – have designed for 1937.

Jan. 11 to 15 1937

All *at the* 32nd SAE

ANNUAL MEETING

Book-Cadillac Hotel **Detroit**

★ ***See Following Pages for Detailed Program*** ★

SAE ANNUAL MEETING

PROGRAM

Monday, January 11

10:00 A.M. **Transportation and Maintenance**

H. W. Drake, Chairman

Vehicle Design from a Maintenance and Operating Standpoint – F. L. Faulkner, Armour and Co., and collaborators.

10:00 A.M. **Fuels and Lubricants**

T. B. Rendel, Chairman

A Sparking Plug, Adapted for Measuring Cylinder Head Temperatures – G. D. Boerlage and A. G. Cattaneo, Royal Dutch Shell Engine Research Station, Delft, Holland. To be presented by A. G. Marshall, Shell Oil Co.

Factors Affecting Relative Knocking Characteristics of Motor Fuels in Service – John M. Campbell, Wheeler G. Lovell and T. A. Boyd, General Motors Research Corp.

2:00 P.M. **Truck, Bus and Railcar**

A. Gelpke, Chairman

Rear Engine Clutch and Transmission Developments – C. D. Peterson, Spicer Manufacturing Corp.

Factors in Engine Temperature Control – H. E. Winkler, Schwitzer-Cummins Co.

2:00 P.M. **Fuels and Lubricants**

J. B. Hill, Chairman

Development of an Altitude Knock Test Method – W. M. Holaday and G. T. Moore, Standard Oil Co. of Indiana

Influence of Humidity on Knock Ratings – J. R. MacGregor, Standard Oil Co. of California

Effect of Knock Intensity on Fuel Knock Ratings – Neil MacCoull, The Texas Co.

8:00 P.M. **Junior-Student**

J. J. Frey, Chairman

Electrical Control of Industrial Units – Ralph Powers, Electronic Control Corp.

Engineer's Social Responsibility – Dr. James S. Thomas, Chrysler Institute of Engineering and Clarkson College of Technology

Tuesday, January 12

10:00 A.M. **Tourist Trailers**

A. G. Herreshoff, Chairman

Where Is the Trailer Going? – Philip H. Smith, Pawling, New York

2:00 P.M. **Diesel Engine**

F. M. Young, Chairman

Correction of Diesel Engine Performance for Changes in Atmospheric Conditions – C. Fayette Taylor, Massachusetts Institute of Technology.

Compression-Ignition Engine Performance at Altitude Conditions – C. S. Moore and J. H. Collins, Jr., National Advisory Committee for Aeronautics, Langley Field

Diesel Operation – C. G. Anthony, Pacific Freight Lines

7:45 P.M. **Business Session**

President R. R. Teetor, in the Chair

Nomination and Election of Members-at-Large of Annual Nominating Committee

Announcement of Election of Officers for 1937

Presentation of Life Membership to Past-President D. G. Roos

8:00 P.M. **Passenger Car Safety**

Miller McClintock, Chairman

1940? – Lieut. F. M. Kreml, Director, Safety Division, International Association of Chiefs of Police

Relating Highway Planning to the Traffic Requirements – T. H. MacDonald, Chief, Bureau of Public Roads, Department of Agriculture

An Automobile Engineer Looks at Safety – W. J. Davidson, General Motors Corp.

Wednesday, January 13

10:00 A.M. **Diesel Engine**

A. W. Pope, Jr., Chairman

Diesel Engines in Trucks – B. B. Bachman, Autocar Co.

Cetane Numbers, Life Size – Lieut.-Comm. R. F. Good, U. S. Engineering Experiment Station, Annapolis

10:00 A.M. **Passenger-Car Body Symposium**

R. J. Waterbury, Chairman

The Aircraft Trend in Body Structural Design – Edward G. Budd, E. G. Budd Manufacturing Co.

The Chassisless or Unit Car Question – Stanley E. Knauss, Motor Coach Division, Gar Wood Industries

Criticisms from the Aircraft Viewpoint – Ralph Upson, Consulting Aeronautical Engineer, Detroit

Modern Body Structure and the Service Problem – Howard D. Brown, general attorney, Detroit Automobile Inter-Insurance Exchange

Book-Cadillac Hotel, Detroit, Mich.

2:00 P.M. **Ring-Sticking Symposium**

A. L. Beall, Chairman

Observations on Cylinder Bore Wear – Max Roensch, Chrysler Corp.

A Mechanical Solution of the Diesel Engine Piston Ring-Sticking Problem – A. W. Pope, Jr., Waukesha Motor Co.

Engine Temperature as Affecting Lubrication and Ring Sticking – C. G. A. Rosen, Caterpillar Tractor Co.

The Problem of Ring Sticking in Aviation Engines – O. C. Bridgeman, National Bureau of Standards

8:00 P.M. **Tractor**

A. W. Lavers, Chairman

The Tractor – Brother to the Automobile – V. P. Rumely, Hudson Motor Car Co.

The Cavalcade of Farm Mechanization – Harry G. Davis, Director of Research, Farm Equipment Institute

Thursday, January 14

10:00 A.M. **Passenger Car Engines**

E. H. Smith, Chairman

Powerplant Possibilities of the Immediate and the More Remote Future – P. M. Heldt, *Automotive Industries*

2:00 P.M. **Passenger Car Lubrication**

W. S. James, Chairman

Extreme Pressure Lubricants for Hypoid Axle Gears – W. R. Griswold, Packard Motor Car Co.

2:00 P.M. **Aircraft**

Mac Short, Chairman

Spot and Seam Welding of the Aluminum Alloys – G. O. Hoglund, Aluminum Co. of America

Gust Loads on Airplanes – Richard V. Rhode, National Advisory Committee for Aeronautics, Langley Field

Ocean Air Transportation – L. C. McCarty, Jr., Glenn L. Martin Co.

6:30 P.M. **Dinner**

V. P. Rumely, Chairman, Detroit Section

W. J. Davidson, Toastmaster

K. T. Keller

The Airship and Its Place in Modern Transportation* – Doctor Hugo Eckener, Chairman of the Board, German Zeppelin Transport Co.

R. R. Teetor, President S.A.E.

H. T. Woolson, President-Elect

Presentation of the Vincent Bendix Trophies

*** Dr. Eckener's talk will be broadcast over the N.B.C. Blue Network (coast to coast), 9:00 to 9:30 p.m. Eastern Standard Time.**

Friday, January 15

10:00 A.M. **Aircraft Engines**

Opie Chenoweth, Chairman

Aircraft Engine Materials – J. B. Johnson, U. S. Army Air Corps, Wright Field

2:00 P.M. **Aircraft Engines**

Robert Insley, Chairman

High Output – And How? – Val Cronstedt and R. N. DuBois, Aviation Manufacturing Co., Lycoming Division

The Measurement of Engine Friction – M. K. McLeod, Massachusetts Institute of Technology

8:00 P.M. ***Production***

K. L. Herrmann, Chairman

Developments in Close Machining Practice in Automotive Production – Fred Pyper, Buick Motor Co.

Budgeting Expense and Cost of Handling Materials in Automotive Plants – George Miller, Budget Supervisor, Chrysler & Chrysler-Kercheval Plants of Chrysler Corp.

Come to the

Dinner

Thursday, Jan. 14

Tickets $3.50 each
Non-members $5.00 each

• • •

Mail Reservations to
Detroit Section SAE
2-136 General Motors Bldg.
Detroit, Mich.

Visit the Engineering Exhibit
Book-Cadillac Hotel
See list of exhibitors on page 34

Standards Divisions Prepare Reports for Annual Meeting Action

DIVISIONS of the Standards Committee have been putting finishing touches on new projects, revisions and recommendations for presentation to the general Standards Committee and the SAE Council for final approval and adoption at the Annual Meeting in Detroit, Jan. 11-15. These will be included in the 1937 SAE HANDBOOK which is to be published as soon as possible after the meeting.

The Tractor Activity Committee and the Tractor and Equipment Division met in Chicago on Dec. 2, reviewing and recommending the final draft of the tractor testing code which has been referred to in earlier issues of the SAE JOURNAL. The committees jointly referred the code to the American Society of Agricultural Engineers for their approval and adoption in accordance with the original plan to publish the code as a joint SAE-A.S.A.E. Standard. Prof. C. W. Smith, University of Nebraska, is chairman of the subdivision that drafted the code.

Flanged Mounted Magnetos for Tractors

Early this year the Tractor and Equipment Division proposed that an SAE Standard be adopted for flanged mounted magnetos on tractors. The required data for such a standard have been received and at the Dec. 2 meeting a final proposal was recommended for adoption.

Electric Lamp Bases

Meeting on Dec. 7 the Lighting Division took action on six projects.

The present standard for bulb bases was reviewed with changes to bring it up to date which include a new double-contact base of the standard bayonet type having an offset locking pin.

Sockets, Plugs and Connectors

Adoption of a standard for pinched-in sockets for use only in headlamps or focusing reflectors, was recommended on the basis of a report by A. N. Taylor, who reviewed this subject, working as a subdivision. A new miniature socket and a new metal cap for large plugs was also recommended, together with a more complete specification for screw type connectors.

Automobile Lamps

New specifications for emergency electric lanterns to mark positions of trucks stalled at night, for clearance, marker and identification lamps to be used on large vehicles, and for fog lamp illumination, were considered. All were recommended for adoption with the exception of those for fog lights which were referred back to the Division for further laboratory check. These specifications, together with a review of tail lamps and signal lamps (stop lights and direction signals), also approved, were prepared by a subdivision of which V. J Roper was chairman.

Tractor Tire Tests

The soils of Illinois and Arizona are being used by the SAE Tractor and Industrial Power Equipment Committee in conducting tests on pneumatic tires for tractors. Tests in the vicinity of Sterling, Ill. have been completed and the data compiled in a report that has been distributed to committee members. Further tests are going on near Phoenix, Ariz. Some of the equipment used is pictured on these pages.

There is a possibility that the testing program will be extended to include both tractor and implement wheels at the newly erected experimental station of the United States Department of Agriculture at Auburn, Ala. This is now receiving careful consideration as a joint project by committees of the SAE and the American Society of Agricultural Engineers.

Motor Vehicle Lighting Inspection Code

Last February the Lighting Division formulated and approved a code, in cooperation with the SAE Highway Research Committee, for the inspection and maintenance of headlighting equipment on motor-vehicles in use. The project was primarily undertaken in conjunction with the preparation of Interstate Commerce Commission regulations under the 1935 Motor Carrier Act for trucks and buses in interstate operation. The Lighting Division is recommending that this code be adopted by the Society and published in the SAE HANDBOOK as an official guide to various state and regulatory officials for uniform practice in road inspection of motor-vehicles in operation.

Motor-Vehicle Headlamps

The preparation and issuing of laboratory acceptance test specifications for motor-vehicle headlamps have been a continuing subject in the Lighting Division with the cooperation of the Illuminating Engineering Society for many years. The SAE specifications have been revised from time to time to keep up-to-date with the developments in headlighting. The interest that has developed from the safety point of view has led to the necessity of reconsidering the specifications to provide adequate road illumination under modern night driving conditions. The Lighting Division has accordingly given this

subject much study and now recommends the adoption of a revised specification for minimum laboratory test requirements for acceptable headlighting. It is expected that this new specification is a step toward providing improved headlighting, and that as headlamp designs improve the specifications can be readily modified to keep pace with such improvements.

Polarized Headlamps

Recently the Bureau International de Normalisation de l'Automobile advised the Society that Technical Committee 22, under the International Standards Association, passed a resolution that the plane of polarization for motor-vehicle headlamps be at an angle of 45 deg. to the horizontal and extending from the upper left to the lower right quadrants of the headlamps, when facing towards the lamps. Although there is apparently little specific data available on this type of lamps and none of them are in commercial use, the Lighting Division feels that a definite standard should be adopted if polarized headlamps are to be of value should they come into widespread use. The division accordingly informally endorsed the resolution of ISA Committee 22 with the additional stipulation that the light interceptor, that is, the windshield or glasses, should also be polarized in the same plane, as, otherwise, polarized headlamps would be ineffective. The division authorized the appointment of a subdivision to study headlamp polarization for the purpose of obtaining data on which to formulate a definite standard for later adoption by the Society. One of the problems to be worked out by the subdivision is the necessity for higher lamp wattages, because of light absorption by the polarized glass, than can be had with present legal headlighting equipment.

Insert Valve Seats

A proposed new SAE recommended practice was developed early this year by a subdivision of the Gasoline Engine Division, under the chairmanship of L. P. Kalb, for a regular series of insert valve-seats normally for use in passenger-car engines, and for a heavy duty series normally for use in truck and bus engines. The report establishes standard dimensions for the bores in the cylinder block with the exception of the axial thickness of the insert, so that inserts of any material may be designed to fit these standard bores.

Poppet Valves

Both the Subdivision on Insert Valve Seats and the Gasoline Engine Division have reviewed the present SAE Standard for poppet valves (p. 11, 1936 HANDBOOK) and have recommended that this specification be cancelled as obsolete. It was agreed that modern valve designs are governed by so many uncontrollable factors of engine design that a poppet-valve standard is at present of little practical use.

SAE Council Approves Committee Appointments

MEETING on Dec. 16 the SAE Council approved appointments to various SAE Committees and of members to serve as representatives of the Society to other organizations, as follows:

S. D. Heron to serve for a term of three years, starting January, 1937, on the Manly Memorial Medal Board of Award.

C. E. Stryker to serve on the Wright Brothers Medal Board of Award for three years, beginning January, 1937.

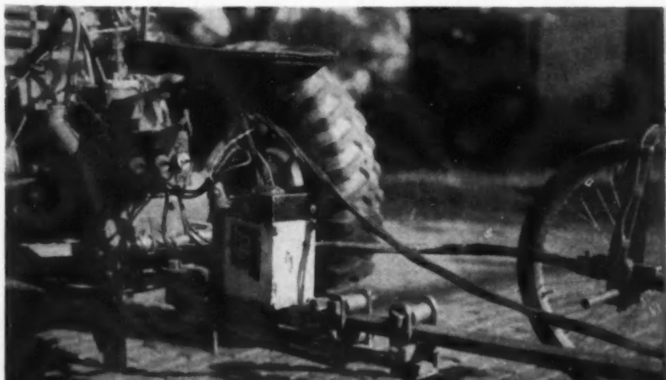
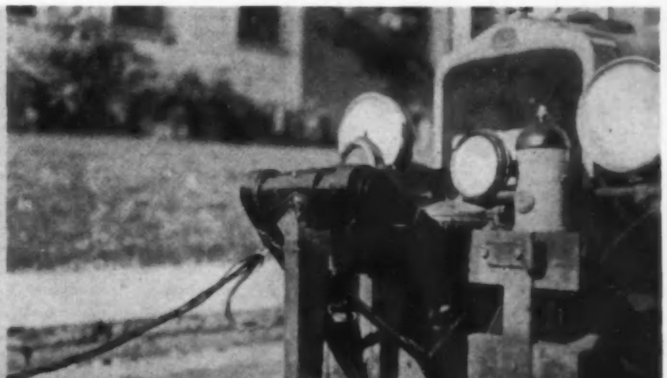
M. C. Horine to continue as alternate on the Standards Council of the American Standards Association for one year.

Appointments approved to the Ordnance Advisory Committee are Col. H. W. Alden, chairman; W. G. Wall, vice-chairman; L. R. Buckendale, alternate for Colonel Alden; E. F. Norelius; Paul Weeks; H. T. McDonald, alternate for Mr. Weeks; G. A. Green; C. J. Bock; alternate for Mr. Green; J. E. Hale; A. W. S. Herrington; A. J. Scaife; Robert Insley; G. A. Round; E. A. Johnston, and A. W. Scarratt, alternate for Mr. Johnston.

Appointments to the Annual Meeting Dinner Committee approved are Col. H. W. Alden, chairman; V. P. Rumely, vice-chairman; B. B. Bachman, F. L. Faulkner, W. B. Hurley and H. T. Woolson.

The Council also approved the new office of vice-chairman for aeronautics of the Southern New England Section. The Section has elected C. H. Chatfield to this post.

Equipment Used in Making Tractor Tire Tests

(*Left*) Rear-end view of tractor with recording dynamometer and bicycle measuring wheel. (*Right*) Front end of traction truck showing hydraulic pressure arrangement.

About SAE Members:

H. O. Mathews, formerly superintendent of motor equipment, Illinois Bell Telephone Co., Chicago, started Dec. 1 as automotive engineer, Public Utility Engineering and Service Corp., also in Chicago. Mr. Mathews is secretary of the Chicago Section.

William F. Barge is tool engineer with the Wright Aeronautical Corp., Paterson, N. J. He was previously chief tool engineer of the Lycoming Manufacturing Co., Williamsport, Pa.

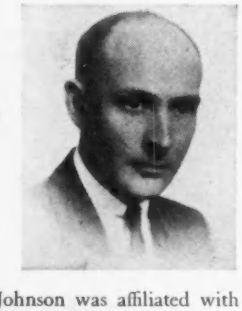
Capt. Edward V. Rickenbacker will receive the Poor Richard Medal of Achievement

E. V. Rickenbacker
Medalist

at the annual dinner of the Poor Richard Club, Philadelphia, Jan. 15. This award, which is given annually to an outstanding American in his field of endeavor, was presented last year to *Alfred P. Sloan, Jr.,* president of General Motors.

C. C. W. John has been transferred from his position as technical engineer with the Shell Co. of Egypt, to a similar position with the Shell Co. of East Africa, Ltd., with headquarters at Nairobi, Kenya. Mr. John will assume his new duties in March. At present he is in London, England.

Forrest L. Johnson, who for the last three years was connected with the De Vilbiss Co., Toledo, Ohio, as tool engineer, has joined the Alexander Milburn Co., Baltimore, Md., as



Forrest L. Johnson
Changes Companies

superintendent. Mr. Johnson was affiliated with the Westinghouse Electric & Manufacturing Co. and the National Cash Register Co. prior to his connection with the De Vilbiss Co.

W. E. England, formerly chief engineer of the Ohio Rubber Co., has taken a position with the Willys-Overland Co.

M. D. Munn has joined the Chrysler Corp. as transportation engineer in charge of truck sales and service in Buenos Aires, Argentina. He was previously chief tool engineer of the the White Motor Co., Cleveland.

Dr. Jerome C. Hunsaker, in charge of mechanical and aeronautical engineering, Massachusetts Institute of Technology, and *George J. Mead* vice-president and chief engineer, United Aircraft Corp., are co-authors of an article, "Around the Corner in Aviation," appearing in a recent issue of M.I.T.'s Technical Review.

Major E. E. Aldrin, manager, aviation department, Standard Oil Development Co., and *Temple N. Joyce,* president, Bellanca Aircraft Corp., have been named members of a new executive committee of Air Service Post 501 of the American Legion.

James D. Mooney, president, General Motors Export Co., has been elected to the governing council of New York University. Mr. Mooney received the first Bachelor of Science degree awarded by the N.Y.U. School of Commerce, Accounts and Finance, in 1927.

John C. Moore is in the engineering department of Rex Manufacturing Co., Connersville, Ind. He was formerly affiliated with the Ro-Peller Manufacturing Co., same city.

Leslie Peat, for the past year a member of the editorial staff of *American Machinist,* has been transferred to the editorial staff of *Business Week,* also a McGraw-Hill publication.

Leslie Peat
Transferred

Formerly editor of *Automotive Industries,* Philadelphia, he was active in the Philadelphia Section. Now a member of the Metropolitan Section, Mr. Peat is serving on its Membership and Publicity Committees.

H. E. Clemens, who was formerly superintendent of maintenance and equipment, Pacific Greyhound Lines, Los Angeles, has a similar position with the Southern California Freight Lines, also in Los Angeles.

E. A. Dallmann is affiliated with the McCord Radiator & Manufacturing Co. in Plymouth, Ind.

On Agricultural Program

When the American Society of Agricultural Engineers held its Winter Meeting in Chicago, Nov. 30 to Dec. 4, several SAE members contributed to the program. *O. E. Eggen,* chief engineer, Oliver Farm Equipment Co., was chairman of the Power Machinery Division and presided at several sessions. *R. B. Gray,* Bureau of Agricultural Engineering, U. S. Department of Agriculture, presented a paper on "Farm Machinery Trends in Europe," and *C. E. Frudden,* chief engineer, Allis Chalmers Manufacturing Co., presented prepared discussion on the subject of "Agricultural Requirements of the Small-Type All-Purpose Tractor from a Tractor Engineer's Viewpoint."

Fred C. Patton
Advanced

Fred C. Patton has been advanced to manager of the Los Angeles Motor Coach Co. and superintendent of motor transportation of the Los Angeles Railway Corp. He was previously assistant manager of the Los Angeles Motor Coach Co.

Karl Brozyna has been awarded the Crompton Medal by the Institution of Automobile Engineers, London, for his paper, "Cylinder Materials and Finish from the User's Point of View," which was selected as the best paper presented during its 1935-1936 session.

Arthur H. Wilson is sales engineer for the Seagrave Corp., Columbus, Ohio., with headquarters in Atlanta, Ga. He was formerly sales engineer in Atlanta for Peter Pirsch & Sons Co., Kenosha, Wis.

August S. Duesenberg is experimental engineer for the Auburn Automobile Co., Connersville, Ind. He was previously chief engineer of the Duesenberg Motors Co., Indianapolis.

Vincent Bendix, president, Bendix Aviation Corp. has been elected director-at-large by the National Association of Manufacturers.

Arthur R. Fors has been appointed works manager of Airtemp, Inc., a subsidiary of Chrysler Corp. He has been identified with Chrysler for several years in plant supervision, as well as supervision of production and manufacturing. Mr. Fors was general works man-

A. R. Fors
New Appointment

ager, Continental Motors Corp., before joining Chrysler. There he had general supervision of all manufacturing of the Continental Motors plants in Detroit, Muskegon and Grand Rapids.

Famous Flight Commemorated

Dec. 17, National Aviation Day, was the 33rd anniversary of the famous Kitty Hawk flights made by Orville and Wilbur Wright in 1903. Orville Wright, who has been a member of the Society since 1916, was at the controls on the first flight. Edgar S. Gorrell, Dr. George W. Lewis, Leighton W. Rogers and Chester H. Warrington are SAE members who served on the National Aviation Day committee.

Frederick J. Griffiths has resigned as president and director of the Timken Steel and Tube Co. and director of the Timken Roller Bearing Co.

Lowell H. Brown, president of Jaray Streamline Corp. of America is wintering at Lausanne, Switzerland. He writes that he is doing some interesting aerodynamic work on motor cars, using the new wind tunnel at Zurich University.

Sidney Robert Milburn, who has been district sales manager of B. F. Goodrich Co. in New York, has been transferred to Akron, Ohio, where he is sales representative.

Joseph Geschelin, Detroit technical editor, Chilton publications, has recently addressed the Rockford Associates, Rockford, Ill., and the Mallory Engineers Club, Indianapolis, upon the various phases of engineering design and their influences upon production techniques. These talks included an analysis of 1937 cars and some discussion of future trends.

Walter F. Roeming, formerly engineering layout man, International Harvester Co., Chicago, has joined the Hercules Motors Corp., Canton, Ohio. He is checker in the Diesel engineering department.

Harry R. Krieter is standards engineer with the Ternstedt Manufacturing Division of General Motors Corp., Detroit. He was previously clutch engineer, Perfection Gear Co., Harvey, Ill.

George Alexander Jewell has joined the Ward Motor Vehicle Co., Mt. Vernon, N. Y., as engineer. He was formerly on the engineering staff of Hercules Campbell Body Co., Tarrytown, N. Y.

W. N. Shepard has been promoted from sales engineer to western sales manager by the Plaskon Co., Inc., Toledo, Ohio.

Diesel Progress Celebrated

Four members of the SAE were among the ten prominent speakers at a luncheon in memory of Dr. Rudolf Diesel, inventor of the engine bearing his name, sponsored by the Diesel Committee of the Exposition of Power and Mechanical Engineering at the Waldorf-Astoria Hotel, New York, Dec. 2. C. L. Cummins, president, Cummins Engine Co., described the 22,000-lb. Diesel-powered truck which set a record of 10,005 miles at 43.8 m.p.h., without pausing to refuel. Edward G. Budd, president of the Edward G. Budd Manufacturing Co., predicted that Diesel engines, fueled by crude oil, will supplement and in some cases supplant the present gasoline and steam motive power. Capt. Edward V. Rickenbacker, vice-president, Eastern Airlines, visualized Diesel engines of from 1000 to 5000 hp. powering giant air liners carrying from 100 to 300 passengers at cruising speeds ranging from 200 to 300 m.p.h. Charles F. Kettering, vice-president, General Motors Corp., unable to attend, addressed the audience by radio from Detroit.

. . . . At Home and Abroad

Herbert Chase, consulting engineer, and *W. P. Kennedy,* president, Kennedy Engineering Corp., are authors of chapters in the section on transportation of the Electrical Engineers' Handbook, recently published by John Wiley & Sons, Inc., New York. The chapter by Mr. Chase is "Electrical Equipment of Internal Combustion Automobiles" and that by Mr. Kennedy, "Electric Automobile."

Fred S. Kramer is sales engineer for the Pilot Tool & Machinery Co., Pty., Ltd., in Johannesburg, South Africa.

M. D. Munn, formerly of the White Motor Co., has joined the Chrysler Corp., export department.

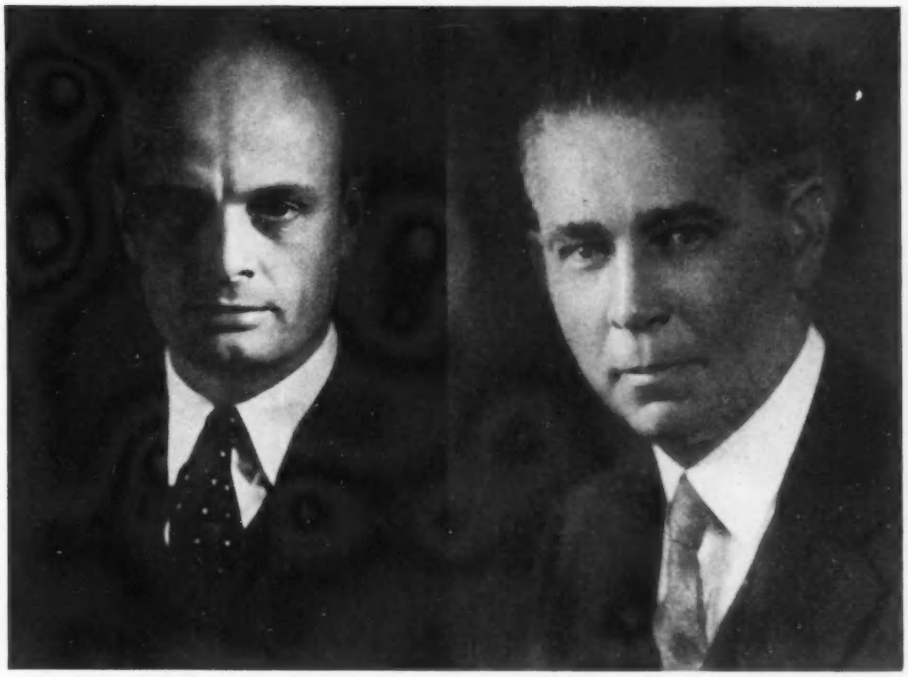
Bart Cotter has joined the mechanical parts engineering department of the Fisher Body Corp., Detroit. He was formerly chief body draftsman, Auburn Auto Co., Auburn, Ind.

Maj. William B. Robertson has been elected president of the newly-formed Robertson Aircraft Corp., Robertson, Mo., which succeeds the Robertson Airplane Service Co. The new company plans to produce light, inexpensive airplanes powered by twin automobile engines. Major Robertson was vice-president and director of the former company.

At Patent Dinner

On Nov. 23 the Centennial Celebration of the American Patent System was held in Washington. Charles F. Kettering, chairman of the National Committee for this affair, was toastmaster at the banquet which followed an all-day program. Serving with Mr. Kettering on the National Committee were SAE President Ralph R. Teetor and SAE Members William L. Batt, Col. Edgar S. Gorrell, William A. Irvin, Alvan Macauley and Orville Wright.

Truck Companies Name New Chief Engineers



W. R. Spiller has been appointed chief engineer of the White Motor Co., following the resignation of _Frank G. Alborn._ Mr. Spiller joined the White company in 1922, immediately after receiving his B.S. in M.E. from the University of Pennsylvania. At that time he was technical apprentice and did machine and assembly work in several of the company's shops. Soon afterward he was transferred to the laboratory where he was, at first, assistant and later laboratory engineer. Following this he became assistant research engineer and was then advanced to truck engineer, which position he held at the time of his new appointment. Mr. Spiller is an active member of the Parts and Fittings Division of the SAE Standards Committee.

Adolf Gelpke has been made chief engineer of Autocar Co., functioning as in the past under B. B. Bachman, vice-president in charge of engineering. Previously he was assistant chief engineer. Mr. Gelpke started to work for Autocar as a blueprint boy in 1910, acquired his technical education in seven years of night school at Drexel Institute of Technology, for some time served on the faculty of University of Pennsylvania and also was instructor in automotive construction at the evening school of the Germantown Y.M.C.A. He has just completed a term as vice-president of the SAE representing Truck, Bus & Railcar Activity, is a past chairman of the Philadelphia Section, and is active in many SAE projects.

Sherman W. Bushnell, Northwest Section chairman in 1933-1934, arrived in New York on a business trip early last month. He visited four SAE Sections and attended the Automotive Service Industries Show in Chicago on his return trip to Seattle, where he is manager of the Automotive Engineering Co.

Charles Martin Hannum is engineer with the National Tool Co., Cleveland, Ohio.

F. Francis Donoghue has joined the Worthington Pump & Machinery Co., Buffalo, N. Y., as experimental engineer. He was formerly in the hot-air heater department, Houde Engineering Corp., also in Buffalo, as design engineer.

Calvin Tuller Austin is engineer with the Los Angeles Bureau of Water & Power, Los Angeles.

George W. Winter recently has been appointed official timer, first class rating, Federation Aeronautique International. This office is held by only 16 representatives of the countries affiliated with the F.A.I. Mr. Winter is instructor at the Automotive High School, Cincinnati.

Takatoshi Kan has been named director of Toyoda Automatic Loom Works, Ltd., Kariya Nr. Nagoya, Japan, manufacturers of automatic textile machinery and automobiles. He was previously chief engineer.

George W. Brisbin is superintendent of automobiles and safety, The Peoples & Columbia Natural Gas Companies, Pittsburgh.

E. J. Cosford, formerly president, Associated Equipment Co. of Canada, Ltd., West Montreal, Quebec, has been appointed general manager of Mack Trucks of Canada, Ltd.

With Tourist Trailer Company

Three SAE members, *R. M. Crouse, E. S. Quarngesser* and *John A. White,* recently have become associated with the Auto Cruiser Corp. of America, Baltimore, Md. Mr. Crouse and Mr. Quarngesser are retaining their affiliations with the Warner-Fruehauf Co., Baltimore, as secretary-treasurer and co-partner respectively. In the Auto Cruiser company Mr. Crouse is assuming the duties of vice-president in charge of production and Mr. Quarngesser those of secretary. Mr. White, former chairman of the Baltimore Section, is devoting his whole time to the Auto Cruiser company as general sales manager. He was previously district manager for the Mack Truck Co.

Carl William Floss is engaged in industrial research and development work with offices in Detroit, Mich. He was previously design engineer with the Hoffman Motor Developments Co., also in Detroit.

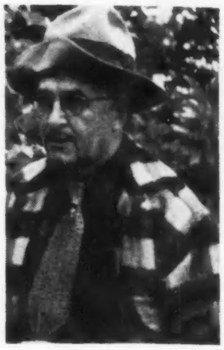
C. E. Patterson, formerly vice-president in charge of engineering, manufacture and sales, Athey Truss Wheel Co., has opened engineering and sales offices in Chicago for Modernized Crawler Wheel Equipment.

Walter G. Retzlaff has been named sales manager of the wholesale division of Fruehauf Trailer Co. He will make his headquarters in Detroit. Previously Mr. Retzlaff was in charge of sales engineering.

L. P. Croset recently has severed his connection as design engineer with the National Gas and Oil Engine Co., Ltd., Ashton-under-Lyne, England, and has joined the staff of Crossley-Premier Engines, Ltd., Sandiacre, near Nottingham, in the capacity of designing engineer.

J. George Oetzel has returned to the engineering staff of Fairbanks-Morse & Co., Beloit, Wis., after having served for a number of years as chief engineer for the Atlas Imperial Diesel Engine Co., Mattoon, Ill.

Howard Baxter
Sales Manager



Howard Baxter, past-chairman of the Northern California Section, has joined the Super-Power Spark Plug Co., Oakland, Calif., as sales manager.

Walter Nowak is on the engineering staff of the Chicago, Burlington & Quincy Railroad Co., Chicago, Ill., as designer and calculator on forces and stresses.

R. W. Hautzenroeder has joined the Fate-Root-Heath Co., Plymouth, Ohio, as chief engineer, tractor division. He was formerly mechanical engineer and chief draftsman, Empire Sheet & Tin Plate Co., Mansfield, Ohio.

Edward L. Bauer is engineer with the Hastings Manufacturing Co., Hastings, Mich.

A. N. Petroff, who formerly did design and stress analysis work for the Northrop Corp., Inglewood, Calif., has joined the Glenn L. Martin Co., Middle River, Md., as aeronautical engineer.

Receives Daniel Guggenheim Medal

Wide World Photo

Dr. George W. Lewis, *center*, received the Daniel Guggenheim Medal "for outstanding success in the direction of aeronautical research, and for the development of original equipment and methods," at a dinner given in his honor by The Institute of the Aeronautical Sciences in New York, Dec. 4. He is pictured here with Harry F. Guggenheim, *left*, who made the presentation, and Maj. E. E. Aldrin, president of the Daniel Guggenheim Medal Fund, who spoke briefly of its history. SAE President Ralph R. Teetor was a guest of honor. The SAE is co-sponsor of the Daniel Guggenheim Medal with the American Society of Mechanical Engineers and The Institute of the Aeronautical Sciences.

Albert C. Schulz

Maj. Albert C. Schulz died suddenly on Nov. 25, 1936, at his home in Bridgeport, Conn. He was 61 years of age. Major Schulz was a pioneer in the automotive industry, affiliating with it in 1902 when he became associated with Andrew L. Riker in the development of motor cars. From about 1905 until 1916 he was assistant chief engineer of the Locomobile Co. In the latter year he joined the Mercer Motor Car Co., as chief engineer. During the World War he served as major in the Ordnance Corps. Leaving Mercer in 1920 he engaged in several engineering projects, and held responsible positions with Bragg & Kliesrath and Bendix. He retired from active business in 1931. Major Schulz was one of the earliest members of the SAE, having joined the Society in 1905.

James T. Kennedy

James T. Kennedy, manager, manufacturers' sales, B. F. Goodrich Rubber Co., whose headquarters were in Detroit, died on Nov. 4, 1936. Mr. Kennedy, who joined the Society in 1922, had been affiliated with the Goodrich company since 1912. He became manager of manufacturers' sales in 1929. He was born in Rochester, N. Y., in 1874.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Nov. 10, 1936, and Dec. 10, 1936.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

ASTRUP, WILLIAM V. (A) chief draftsman, radiator division, Young Radiator Co., 709 Marquette, Racine, Wis.; (mail) 912 Blaine Blvd.

BAKER, LEWIS ROSCOE (A) sales manager, McKinnon Columbus Chain, Ltd., St. Catharines, Ontario, Canada.

BENNETT, H. T. (M) chief chemist, Mid-Continent Petroleum Corp., Tulsa, Okla.

COTTER, BART (M) mechanical parts engineering division, Fisher Body Corp., General Motors Bldg., Detroit, Mich.; (mail) 15442 Kentucky.

DALENBERG, ROBERT W. (J) draftsman, International Harvester Co., 2626 W. 31st Blvd., Chicago, Ill.; (mail) 15609 Myrtle Ave., Harvey, Ill.

DONNELL, JOHN W. (M) associate professor, School of Petroleum Engrg., University of Oklahoma, Norman, Okla.; (mail) 213 W. Apache.

ELLIS, GREER (J) aeronautical engineering, Massachusetts Inst. of Technology, Cambridge, Mass.; (mail) 27 Dana St.

FREIDEN, WM. (J) sales engineer, Four Wheel Drive Auto Co., Clintonville, Wis.; (mail) Ward Hotel.

HANKINS, LEWIS PALMER (A) combustion engineer, Gulf Oil Corp., Park Square, Boston, Mass.; (mail) 42 Belvoir Rd., Milton, Mass.

HARRIS, DARROL N. (J) research engineer, Shell Oil Co., Martinez, Calif.; (mail) 936 Court St.

HIGI, BERNARD J. (J) inspector, Delco-Remy Corp., Anderson, Ind.; (mail) 2024 Fletcher St.

HULL, WILLIAM L. (J) mechanical engineer, Chrysler Corp., Engrg. Dept., 12800 Oakland Ave., Highland Park, Mich.; (mail) 914 Forestdale Road, Royal Oak, Mich.

KEISER, CARL J. (A) partner, Keiser Chevrolet Co., Pottstown, Pa.

KOLLBERG, PAUL G. (J) mechanical engineer, Allis Chalmers Mfg. Co., West Allis, Wis.; (mail) 956 N. 31st St., Milwaukee, Wis.

KOON, C. H. (A) salesman, International Harvester Co., 606 S. Michigan Ave., Chicago; (mail) 611 Roosevelt Road.

KOST, H. W. (A) vice-president, treasurer, Prestole Devices, Inc., 6527 Russell, Detroit, Mich.

KRALL, STANLEY (M) manager, product development, Fisk Rubber Corp., Chicopee Falls, Mass.

LAMACHE, ANDREW (J) 1149 Hoe Ave., New York City.

LAUER, A. R. (M) associate professor, psychology, Iowa State College, Ames, Iowa.

LICHTENBERG, F. DELBROOK (J) assistant plant engineer, Perfect Circle Co., Hagerstown, Ind.

LINE, GERALD D. (J) engineer, Wilcox-Rich Div., Eaton Mfg. Co., 9771 French Road, Detroit, Mich.

MARSHALL, C. P. (J) inspector, Fisher Body Corp., 6817 E. 37th St., Leeds, Mo.; (mail) 2828 Harrison, Kansas City, Mo.

MCLAUGHLIN, EDWARD J. (J) junior engineer, Standard Oil Co. of Calif., Richmond, Calif.; (mail) 1221 Bonita Ave., Berkeley, Calif.

MEERDINK, JESS W. (M) chief engineer, Universal Motor Co., Oshkosh, Wis.; (mail) 271 Evans St.

MILBRATH, ROBERT H. (J) lubrication engineer, Standard Oil Co. of N. J., 26 Broadway, New York City; (mail) 170 Columbia Heights, Brooklyn, N. Y.

MILES, FREDERICK GEORGE (M) director, chief engineer, Phillips & Powis Aircraft, Ltd., Reading Aerodrome, Reading, England; (mail) Lands End House, Twyford, Berks., England.

MILLER, NORMAN E. (M) research engineer, charge of development, Vickers, Inc., 1400 Oakman Blvd., Detroit, Mich.

MORRISS, FRANK (A) salesman, R. Angus, P. O. Box 21, Victoria, B. C., Canada; (mail) 845 Yates St.

MOSELEY, J. T. W. (M) assistant chief engineer, Carter Carburetor Corp., 2834-56 N. Spring Ave., St. Louis, Mo.

MYHRE, WILHELM (A) sales representative, General Motors International A/S, Copenhagen, Denmark; (mail) Vettakollen, Oslo, Norway.

NIEDERAUER, WILLIAM J. (J) engineering, B. G. Corp., 136 W. 52nd St., New York City; (mail) 131 King Ave., Yonkers, N. Y.

NORDENSON, WILLARD H. (M) chief engineer, John Deere Wagon Works, Tractor Div., Moline, Ill.

SIESEL, WILLIAM MATHEWS (J) draftsman, Wright Aeronautical Corp., Paterson, N. J.; (mail) 119 S. Prospect St., Verona, N. J.

THOMPSON, J. FRANKLIN (A) 230 W. Chase St., Baltimore, Md.

WOLFRAM, WM. S. (J) engineer, Inland Mfg. Co., Dayton, Ohio.

Applications Received

The applications for membership received between Nov. 15, 1936, and Dec. 15, 1936, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

ANDERSON, MILES H., mechanical salesman, Anderson Auto Service, Oakland, Calif.

BEAN, WILLIAM H., testing engineer, Surface Transportation Corp., Bronx, New York.

BENNETT, ERNEST, general buildings, vehicles and supplies supervisor, Bell Telephone Co. of Canada, Montreal, Que., Canada.

BOORD, HARRY W., special representative, American Oil Co., Pittsburgh, Pa.

BRAKENBERRY, HAROLD O., production engineer, Ternstedt Mfg. Co., Detroit, Mich.

BROWN, LEO F., engineer, General Motors Proving Ground, Milford, Mich.

BROWNLEE, CLARENCE S., president, Dickson Gasket Co., Chicago, Ill.

BURKHALTER, ROBERT R., designer, Spicer Mfg. Corp., Toledo, O.

CARPENTER, CARROLL E., board and paper division, National Automotive Fibres, Inc., Detroit, Mich.

CHESS, GERALD E., engineer, San Joaquin Light & Power Corp., Fresno, Calif.

CONNELL, WILLIAM, JR., manager, W. J. Connell Co., Boston, Mass.

CRONE, ALFRED F., vice president, Acme Steel & Malleable Iron Works, Buffalo, N. Y.

DESMOND, JOHN V., production department, The B. G. Corp., New York City.

DOUBET, FRANK, regional manager, General Motors Truck Co., Chicago, Ill.

EACKER, EARL H., assistant to vice president and engineer of district, Boston Consolidated Gas Co., Boston, Mass.

EDGAR, J. A., research engineer, motor laboratory, Shell Oil Co., Martinez, Calif.

FRANCE, CHARLES W., vice president and general manager, Curtiss-Wright Corp., Robertson, Mo.

GJERDE, M. D., automotive engineering, technical department, Standard Oil Co., Chicago, Ill.

GOVERNMENT OF THE COMMONWEALTH OF AUSTRALIA, Melbourne, Australia.

GRATZ, FRED, 480 Central Park West, New York City.

GREGORY, AUSTIN CHARLES, charge of lubrication department, Shell Oil Co. of Canada, Ltd., Toronto, Ont., Canada.

HEYNES, WILLIAM MUNGER, chief engineer, S S Cars, Ltd., Foleshill, Coventry, England.

HIRTLE, EUGENE G., truck equipment engineer, Isaacson Iron Works, Seattle, Wash.

HONDA, TOMIJIRO, inspector for aviation, Japanese Army Inspector's Office, New York City.

HOPKINS, BEN F., president, The Cleveland Graphite Bronze Co., Cleveland, O.

JOHNSON, RALPH R., industrial coordination, University of Detroit, Detroit, Mich.

KLINGER, JAMES D., in charge of material testing laboratory, Engineering Division, Chrysler Corp., Detroit, Mich.

KUT, WALTER S., experimental department, Waukesha Motor Co., Waukesha, Wis.

LIMBERG, ALFONS A., body engineer, Fisher Body Corp., Detroit, Mich.

MARKS, STANLEY G., assistant engineer, Wilcox-Rich Corp., Detroit, Mich.

MCGRATH, DONALD MARBLE, service department, Eclipse Aviation Corp., East Orange, N. J.

NOURSE, HUGH C., vehicles engineer, Bell Telephone Co. of Canada, Montreal, Que., Canada.

PORTER, HAROLD R., junior engineer, Standard Oil of California, Richmond, Calif.

RAINEY, REXTON S., engineer, Victor Mfg. & Gasket Co., Chicago, Ill.

SASAKI, WASABURO, managing director, Tokyo Jidosha Seizo, Kaisha, Joto-ku, Tokyo, Japan.

SCANTLEBURY, WOODMAN FRANCIS, senior engineer, Nassau County Engineering Department, Mineola, N. Y.

SCHULTZ, JOHN W., automotive engineer, technical department, Standard Oil Co. (Ind.), Chicago, Ill.

SHAPIRO, FRANCIS PETER, salesman, General Auto Electric Co., New York City.

SHEA, JOHN W., service station manager, Mayflower Stations, Inc., White Plains, N. Y.

SHORTER, LEO JOSEPH, chief engineer, Singer Co., Ltd., Coventry, England.

SHUMWAY, ALFRED E., manufacturers' agent, 647 W. Virginia St., Milwaukee, Wis.

SIPOS, JOSEPH N., body draftsman, Fisher Body Corp., Detroit, Mich.

SMITH, LAURIE C., designer, Atlas Imperial Diesel Engine Co., Oakland, Calif.

STRATTON, LLOYD O., factory sales and service, The Buda Co., Harvey, Ill.

TASTROM, HERBERT V., 6 Damson Street, Garden City, N. Y.

TOMLINSON, E. F., sales, B. F. Goodrich Co., Akron, O.

VOKES, CECIL GORDON, managing director, Vokes, Ltd., London, England.

WACHSMUTH, ERNST E., technical advisor, Revere Copper & Brass, Inc., Detroit, Mich.

WACKER, C. W., national account sales, The B. F. Goodrich Rubber Co., Chicago, Ill.

WESTLAKE, VINCENT F., Westlake Brothers Ice & Coal, Fords, N. J.

News of the Society

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Thousand-Passenger Airliners Forecast at Round-Table Meeting

VERBAL pictures of future aircraft and moving pictures of wind tunnels and aeronautical laboratories of four European nations featured the Special Technical Meeting, sponsored jointly by the Society of Automotive Engineers, the American Society of Mechanical Engineers and The Institute of the Aeronautical Sciences, Friday, Dec. 4, 1936, in New York.

Projecting listeners five years into the future, eight outstanding authorities predicted how 1941 aircraft would look and perform, in a round-table discussion of "The Next Five Years in Aviation," presided over by Dr. J. C. Hunsaker, head of mechanical engineering department, Massachusetts Institute of Technology.

Huge airliners weighing 1,000,000 lb. and carrying 1000 passengers were visualized in 1950 by I. I. Sikorsky, vice-president in charge of engineering, Sikorsky Aircraft Division, United Aircraft Mfg. Corp. In the next five years he looks for craft weighing up to 200,000 lb., gaining in efficiency as their sizes increase, and powered by four-in-line and six-in-line engines. As to future performance, Mr. Sikorsky foresees vastly improved comfort, average speeds of 250 m. p. h. over any desired range, and sustained flight at 25,000 ft. Flying boats, he believes, will become relatively more numerous because of the vast spaces available for landing and take-off.

With such giant aircraft, Dr. Alexander Klemin, professor of aeronautical engineering, New York University, foresees difficult problems in stability and control. "Unless these problems are solved," he warned, "the maneuverability of such a 1,000,000-lb. airliner would be so poor that it would take ½ hr. to land or take-off and would require an airport 2 miles long." Hydraulically or electrically powered controls would be necessary to operate such huge aircraft, he predicted.

Average specific fuel consumptions of 0.035 lb. per b.hp-hr. will be reached in the next five years, prophesied C. Fayette Taylor, professor of automotive engineering, Massachusetts Institute of Technology. He showed that present aircraft engines could be stepped up to develop between 1200 and 1600 hp. by increasing mean effective pressures and piston speeds. On two counts – reduced drag and better cooling efficiency at high altitudes – he predicts accelerated development of the water-cooled engine.

"Fuels of 100-octane number will be as standard in five years as 87-octane fuels are today," prophesied Dr. Graham Edgar, director of research, Ethyl Gasoline Corp., "and fuels well above 100-octane number will be used to a considerable extent. These fuels will permit increases in horsepower up to 50 per cent. decreased fuel consumption, or both," he continued. Unless Diesel fuels are improved, Dr. Edgar can see little progress for Diesel engines in aircraft under 2000 hp., within the next five years.

Agreeing with Dr. Edgar, Roland Chilton, consulting engineer, Wright Aeronautical Corp., stated his belief that the Diesel engine must improve faster than the gasoline engine to compete successfully in aviation during the next five years. Conceding the superiority of the Diesel in fuel costs, he emphasized that weight of fuel is the immediate problem, pointing out the constantly improving fuel consumption of the gasoline engine.

Speaking on practical progress in airplane aerodynamics, William Littlewood, chief engineer, American Airlines, Inc., answered claims that the limit of development has been reached – that future development would be in refinement only. The makers of these claims, he contended, neglect the multitude of developments now going on and the importance of so-called refinements.

"A great gain in aerodynamic efficiency will come with the larger airplanes of the next five years because of the larger size of the wings relative to the fuselage," predicted B. C. Boulton, chief engineer, Glenn L. Martin Co. He also looks for a decrease in structural weight because of new, lighter materials, better distribution, and increased knowledge of load applications.

"Today's airship begins with the performance predicted for 1941 airplanes," contended Com. C. E. Rosendahl, commandant of Lakehurst Naval Station, "and the next five years will see regular airship service over the North Atlantic and the Pacific Oceans." Believing that the airship soon will overcome the misunderstanding handicapping it, he predicted that the United States will soon embark on an airship program, greater than ever.

Featured among the moving pictures showing wind tunnels, water tunnels, and aeronautical laboratories of European countries that concluded the meeting, were those that actually showed the path of air flow around various airfoils. In England the flow was photographed by means of Schlieren photography and, in Germany, by means of smoke layers.

Foreign guests who presented the films of their respective countries were: for England, Group Capt. T. E. B. Howe; for France, Col. N. Champsaur; for Germany, Dr. Ing. F. Seewald; and, for Italy, Lt. Col. Vincenzo Coppola.

Wanted—1932 Transactions

Headquarters' supply of SAE TRANSACTIONS FOR 1932 is exhausted. We have an urgent request for a copy. Anyone knowing of one that is available is asked to notify the editor of SAE JOURNAL at 29 West 39th St., New York.

Sees Business As Great Social Power

● Metropolitan

The automotive industry is still fresh because it is still engineer-managed, Dr. William J. Cameron of the Ford Motor Co., declared before some 250 members and guests attending the Dec. 16 meeting of the Metropolitan Section. That, he said, is one reason why it was foremost in leading the country out of our past depression. Section Chairman T. C. Smith welcomed the guests and, as toastmaster, introduced the speakers.

Officers of the National Society, members of the Council and the headquarters' staff were guests of the Governing Board of the Metropolitan Section. President Ralph R. Teetor spoke briefly on "The Advantages of the SAE to Operators – Automotive and Aeronautic," stressing the importance and resultant benefits of close cooperation between manufacturers and those operating vehicles. The SAE, he said, is a clearing house helping both to a common end – the accomplishment of the best possible and the most economic transportation. President-elect Harry T. Woolson spoke on the national aspect of the automotive industry. Only the manufacturing part centers around Detroit; operation centers around every city, he stated, and also pointed out that practically every state supplies some raw materials to the industry.

Stating that in years gone by politicians got all the blame or praise for depression or prosperity, Dr. Cameron said that this has all been shifted to business. And, he added, business should welcome this responsibility because business is one of the greatest of social powers. Business itself, he added, is responsible for bettering working conditions during the past hundred years. He emphatically stated that shorter hours, decrease of child labor, and elimination of unsanitary working conditions have come from within business itself; not from legislation, duress of labor unions or any other outside force. The philosophy of business, he added, is to do decent things.

Looking ahead Dr. Cameron sees greater prosperity; a prosperity based on production rather than speculation. He sees a six-hour day and decentralization.

Speaking specifically of the automotive industry, Dr. Cameron said that the reason for its success is that its pioneers, the men who invented and developed the motor car, were working for an ideal; they had a useful idea and a persistent spirit. He went on to say that few of them had only profit in mind, and that those who did, fell by the wayside. This same spirit, he continued, exists today. With engineers at the helm the industry refuses to stand still and this is proved in the interest the public has shown by flocking to automobile shows to see its products, he added. Following this same thought, Dr. Cameron predicted that the 1937 car will be more of an antique in 1947 than the 1903 museum car is now.

Among the national officers and officers-elect present as Metropolitan Section guests were President Teetor, President-elect Woolson, Councilor Joseph A. Anglada, Councilor-elect A. T. Colwell, Councilor-elect Walter C. Keys, Vice-President-elect John M. Orr, representing Transportation and Maintenance Engineering; Vice-President-elect Stephen Johnson, Jr., representing Truck, Bus & Railcar Engineering; Vice-President Adolf Gelpke, representing Truck, Bus & Railcar Engineering; Vice-President-elect A. L. Beall, representing Aircraft, Engine Engineering; Vice-President-elect William S. James, representing Passenger Car Engineering; Councilor Frederick C. Horner, Treasurer David Beecroft, Vice-President-elect C. Herbert Baxley, representing Fuels and Lubricants Engineering; Vice-President T. B. Rendel, representing Fuels and Lubricants Engineering.

At a reception preceding the meeting the officers and councilors of the National Society were hosts to the Metropolitan Section Governing Board and members of the headquarters' staff.

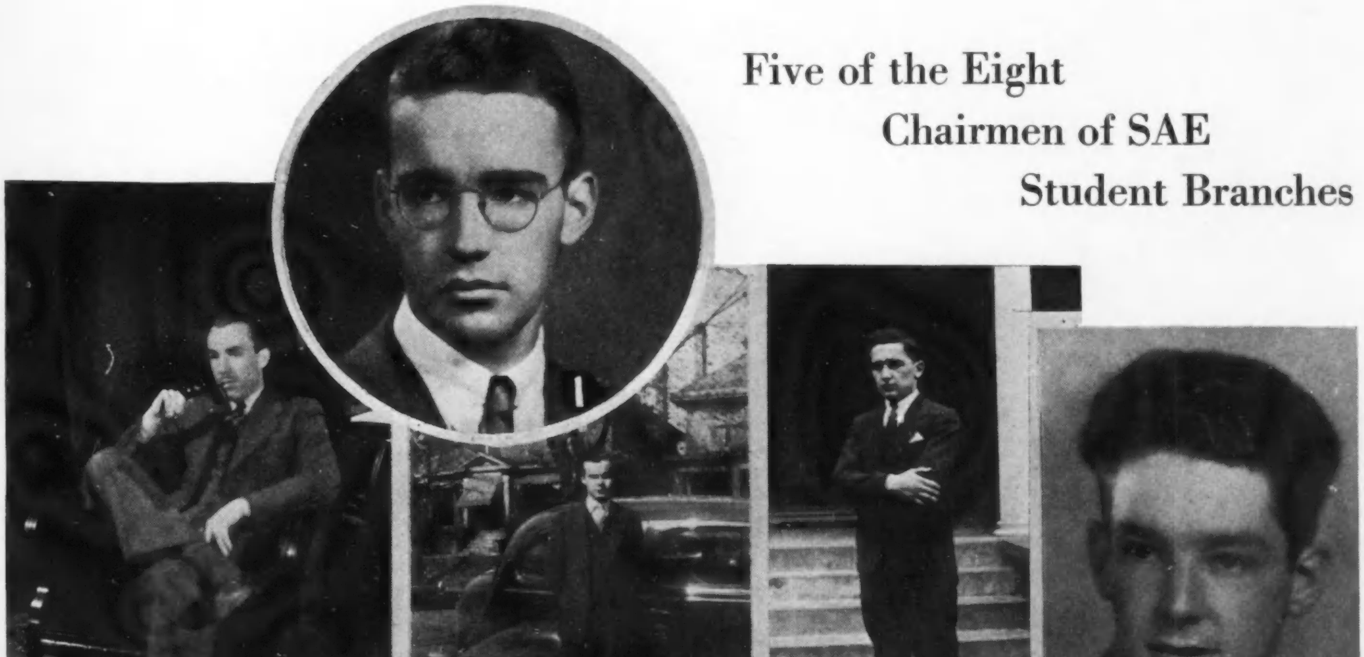
New Student Branch Inaugurated at Purdue

● Purdue

On Dec. 10, SAE President Ralph R. Teetor and officers of the Indiana Section officially welcomed a group of students at Purdue University as a Student Branch of the Society. President Teetor presented the charter which was accepted by Student Chairman M. C. Compton. The engineering faculty of the University and many members of the Indiana Section were on hand to honor the occasion.

As a welcome to President Teetor the University arranged special laboratory displays during the afternoon. The Electrical Engineering School exhibited television, high-voltage and the

Five of the Eight Chairmen of SAE Student Branches



1. David Hunter, *Massachusetts Institute of Technology*. 2. Hamar A. Ball, *General Motors Institute*. 3. Howard Heffley, *Ohio State University*. 4. R. Colby Baker, *New York University*. 5. John P. McDermott, *Oregon State College*

cathode-ray oscillograph. A variable compression C.I. engine, wind-tunnel models and a chassis dynamometer were on display at the Mechanical Engineering School, and at the Chemical Engineering Building photo-micrographs and evaporators were to be seen. The Purdue University Airport and Laboratory attracted many of the visitors.

The presentation of the charter took place at the dinner meeting. Dean Potter, Professors Jacklin and Young and other members of the faculty paid tribute to the Society and the group of students forming the new Branch. Edward F. Lowe, SAE assistant general manager, conveyed greetings from General Manager John A. C. Warner who, at the last moment, was unable to attend. He then spoke on "Keeping the Automotive Industry Young," from a paper prepared jointly by Mr. Teetor and Mr. Warner. Indiana Section Chairman Charles C. Merz and Student Chairman Compton jointly presided at the meeting.

"The Student Branch at Purdue University is off to a good start, and should prove to be one of the most active and progressive student groups," reported Mr. Lowe upon his return to SAE Headquarters.

Student officers serving with Mr. Compton are L. G. Kreiser, vice-chairman, and L. B. Bornhauser, secretary-treasurer.

Suggests Special Name For Hypoid Lubricants

● St. Louis

"The powerful, hypoid-type lubricant should be definitely distinguished from all other E-P lubricants, otherwise there will be much confusion in service," warned J. E. Jury of the Shell Petroleum Corp., in his paper "Extreme-Pressure Lubricants and 1937 Hypoid-Axle Service," presented at the Dec. 18 Meeting of the St. Louis Section.

To solve the problem he suggested the name "hypoid lubricant" that has been adopted by many refiners.

As a "conciliator between technical facts and practical values," Mr. Jury sought successfully to dispel the mysteries of hypoid gears and their lubrication from the minds of those concerned with service and maintenance and to establish a mutual understanding between them and the technicians.

The word "hypoid", he explained, is coined from the Greek prefix hypo meaning beneath. This name is appropriate, he continued, as the pinion can be located *below* the axle level, and thus permit the lowering of the car floors that has featured recent models.

How the hypoid differential gearing developed from the straight bevel type was described by Mr. Jury as the "modern engineer's short story." Design of the spiral-bevel gear was the first step, he went on, as the tooth curvature permitted greater tooth length in contact. Having the greatest number of teeth in contact, and hence the lowest pressure per tooth, the worm gear would seem to be the most desirable but, he explained, a compromise was necessary because the worm gear had certain mechanical, production, and economic weaknesses. Finally, he concluded, the gear designer, metallurgist and chemist formed the arbitration committee that compromised on the hypoid gear.

Development of lubricants for hypoid gears paralleled the development of the gears themselves, Mr. Jury said. He then told of the new problems introduced by the addition in hypoid gears of sliding or rubbing action to that of the pure rolling in spur gears, by higher speeds, and by higher pressures. Factors that must be considered in the specification of hypoid lubricants, Mr. Jury enumerated as the momentary high temperatures developed by the gear sliding under high load, load and tooth pressures, rubbing speeds, and gear finish.

As a result of cooperative work using the SAE E-P lubricant-testing machine, Mr. Jury presented a table that put commercial E-P lubricants under four classifications in order of their load-carrying properties as follows: hypoid lubricants, mild hypoid lubricants, mild E-P lubricants, and gear lubricants.

As to the causes of scoring in hypoid gears, Mr. Jury stated "high pressure and rubbing speeds result in temperatures so high that actual welding occurs in minute areas along the tooth-contact lines." The lubricating film, he continued, must act as an "anti-welding flux" to prohibit metal-to-metal contact between the sliding or rubbing surfaces. A stress of 400,000 lb. per sq. in. is theoretically possible in hypoid gears, and the rubbing or sliding velocity may reach 1800 ft. per min., he pointed out.

Regarding the great diversity of manufacturers' recommendations for E-P hypoid lubricants, Mr. Jury explained that it is not surprising when one considers the fact that car designs, axle designs, operating conditions, production problems, and service problems are different for every make of car.

Tourist-Trailer Makers Study SAE Standardization Facilities

LEADING executives and technicians of the fast-growing tourist-trailer industry got first hand knowledge of SAE standardization facilities and processes when they met with Chairman George McCain and his passenger car standards division in Detroit early in December. Convened to accelerate the work of standardization of trailer couplings, the informal gathering resulted in the outlining of SAE Standards Committee processes as they might be applied to various technical elements of tourist-trailer design development such as brakes, lighting equipment, etc.

Carl W. Schelm, president of the recently organized Trailer Coach Manufacturers Association, said that standardization and legislative recommendations had been discussed at a meeting of the board of directors of his association a short time before and he indicated clearly the possibility of its cooperation with SAE efforts in the standardization field.

Particularly interesting was the discussion of cooperative possibilities because of the representative character of the men present. Executives from 11 trailer companies – including the leading producers – attended as did representatives from 8 equipment factories prominent in the new field. Seven automobile men came from Chrysler, Buick, Pierce-Arrow and similar organizations.

Definite progress was made on the tourist-trailer coupling project. A joint standardization committee was formed to carry forward this project. It is comprised of four automotive representatives, three trailer representatives and two hitch and jack company representatives and will function under SAE standards procedures.

Trailer representatives appointed were Clyde Beattie, Silver Dome, Inc.; F. C. Burt, Vagabond Coach Mfg. Co.; and G. W. Smith, Palace Travel Coach Corp. Coupling and jack representatives are E. C. Swift, Saginaw Plating & Specialty Co., and W. V. Thelander, Atwood Vacuum Machine Co.

Automotive representatives are: A. G. Herreshoff, Chrysler, chairman; Louis Thoms, General Motors; H. S. Jandus, General Spring Bumper Co.; and a representative of Ford, yet to be named.

Many specific suggestions were made, designed to be helpful to the committee when it actually begins to function. Among these were:

(a) A standard coupling should be of the ball type, including ball, throat diameter and stud sizes.

(b) The ball should be as near as possible to the tractor axle and of forged stock.

(c) The standard should provide means for attaching the coupler to the tractor car frame.

(d) Standard height from ground and position of ball with relation to the rear bumper. Sufficient clearance space for coupling mechanism through maximum turning angle of vehicles (60 to 70 deg.).

(e) Height of ball above ground, (17 to 26 in.) suggested, and to be given as minimum and maximum. (Average height from ground of center of gravity on cars is around 27 in.)

(f) Provide for interference with trunk rack, baggage compartment door and changing designs on the tractor.

(g) The articulate point in the coupling should be in line with the centers of gravity of the trailer and tractor.

(h) The static load on the coupling ball (200 to 800 lb.) but balls should be designed to take maximum shock load.

(i) Suggestion that car manufacturers provide dealers with a kit of standard parts required on the tractor, on which a standard ball can be mounted by the trailer manufacturer.

Attributes Loss to Traffic Congestion

● New England

Loss of $300,000 a year is caused by congestion at one Boston street intersection, according to computations from a survey quoted by Maxwell Halsey in his talk before the New England Section, Nov. 5. A like amount spent in correcting conditions leading to this congestion would be a sound investment, he said. Mr. Halsey is associate director of the Harvard Bureau for Street Traffic Research. He told of its work and explained its current program.

Alfred W. Devine, associate registrar of motor vehicles, Commonwealth of Massachusetts, devoted his talk, which was given on the same program, to the problem of headlight glare. Some years ago, he said, the various states made specifications for headlamps and the manufacturers sent the lamps to the states so that they could have the lamps tested and either approve or reject them. Today, he continued, some lamp makers have their own tests made and sell the lamps to car manufacturers without first submitting them to the states for approval. Mr. Devine predicted that this practice will be curbed within another year and that the lamp manufacturers may find it better to cooperate with, rather than ignore state officials. This statement, he said, is not a threat; but he pointed out that lack of headlamp approval by the states might lead to production trouble.

Two motion pictures, "Trial by Torture" and "Horsepower vs. Horse Sense," shown through the courtesy of the Plymouth Motor Corp., illustrated causes of accidents and ways to prevent them.

Myron S. Huckle, chairman of the Section, introduced the speakers and led the discussion.

Steel Making Still An Art, Says McQuaid

• Detroit

With alloy steels becoming more complicated every day, it is essential that there be the closest cooperation between the various divisions of engineering and production in the motor car plants, as well as between the suppliers, according to Harry W. McQuaid, metallurgist, Republic Steel Corp., who addressed the Detroit Section on Nov. 30. As a typical picture of such cooperation he pictured the engineers, the heat-treating foreman, the factory manager, the inspector, and superintendent of the assembly line around a table discussing a problem in transmission noise.

Steel making is still an art, according to Mr. McQuaid, and involves a tremendous lot of judgment, particularly on the part of the melter. Melting down scrap is a tricky job and depends partly on the furnace temperature. Besides, Mr. McQuaid indicated, the furnace itself burns up in the process; the bottom comes up, the roof comes down, and the melter must watch continually a thousand variables that must be caught on the fly.

Engineers who consider purely the analysis of the steel are fooling themselves, Mr. McQuaid stated. His company, he said, is making six kinds of SAE No. 1040 steel for one plant. The variations come largely in grain size and other factors relating to prior heat treatment, he reported. Very often specifications are called for that are in conflict with one another, Mr. McQuaid said. In order to obtain steel that will cold shear in cold weather without cracking, it is necessary to make it tougher, but that adds to the machining cost and subsequent trouble may develop in normalizing and in grinding, he explained as an example.

When called upon from the floor, Mr. McQuaid explained briefly the importance of controlling grain size. Grain size, he said, depends not so much upon the heat-treatment as it does upon the method of deoxidation when melting down and the percentage of aluminum introduced. Coarse-grained steels which have all carbon in solution have maximum hardenability; whereas, fine-grained steels in which the carbon is not in complete solution have minimum hardenability, he explained. The so-called deep-hardening steels, however, according to Mr. McQuaid, are not always an advantage because a certain amount of toughness is lost and brittleness acquired.

Inspects Army Motor Equipment at Fort Lewis

• Northwest

Explaining the Army's system of maintaining its motor equipment in time of war, Lieut. J. A. Ostrand, Engineer Corps, U. S. Army, spoke before the Northwest Section, Dec. 11. In the afternoon members and guests of the Section visited Fort Lewis and, with officers as guides, inspected the maintenance facilities and equipment of the Field Artillery, Signal Corps, Ordnance Department and Quartermaster Corps. Returning to Seattle in the evening the meeting was continued at the Roosevelt Hotel.

Lieutenant Ostrand explained that in war time five echelons of maintenance are provided, ranging from lubrication and minor adjustments performed on the front, to major overhauls, replacement of units and other large jobs performed well back from actual fighting. All maintenance operations, he said, are grouped in these five echelons according to the amount of work involved and the special equipment required for each operation.

The speaker went on to explain the exact uses of each piece of equipment in carrying out the duties assigned to the Engineer Corps in war time, which includes the transportation of personnel and equipment, tools, food, water, and electrical supplies.

On the subject of keeping roads in condition he explained first that the maximum weight of any vehicle in actual war time use is 7½ tons. The heavy traffic passing over these roads makes them subject to considerable punishment, he added. To cope with the problem of keeping them passable, Lieutenant Ostrand said that the Engineer Corps is using dump trucks, power graders, power shovels, tractors, and trailers in addition to hand tools.

The discussion following the paper was lead by Col. H. E. Finch, Post Commander at Fort Lawton.

Only after ten thousand years of brick laying did that art become perfected to its present standard, Prof. H. J. McIntyre told the Northwest Section at its Nov. 20 meeting, in emphasizing strides made in scientific management since 1890 when Taylor and Gilbreth, respectively, first made time and motion studies. Up until then, he said, little or no thought had been given to scientific job study. Professor McIntyre, who is a member of the University of Washington faculty, commercial engineering department, continued by saying that although Taylor and Gilbreth were attacking the problem of job study from different angles they were united in purpose and their results were practically the same.

If every business man were to become more time-and-motion conscious both the employers and the employes would benefit from the resultant progress, he stated, adding that the problem must be approached with an open mind and without consideration of operations or conditions which have been evolved over a period of time.

Record Crowd Hears Wolf on 1937 Trends

• Chicago

Style trends in the new cars here and there show advances toward the tear-drop design, but streamlining is still governed largely by a desire for pleasing appearance and contours acceptable to the public, rather than by true aerodynamics, said Austin M. Wolf, consulting engineer, in his talk before 416 members and guests of the Chicago Section, Nov. 16, the greatest turnout in the Section's history. Prior to the meeting

Blanchard Joins SAE Staff

Donald Blanchard has joined the SAE headquarters staff as secretary of the Engineering Relations Committee.

Charged with supervision of all contacts between the Society and outside agencies, this committee has been faced with demands for constantly increasing service ever since its organization more than a year ago. Particularly has the need become great for a more thorough continuing contact between automotive engineers and technicians of administrative and regulatory agencies to remove technical safety matters from the argumentative class by providing an uninterrupted supply of needed engineering facts. It is to this task in particular that Mr. Blanchard will devote a major part of his energies.

After graduating from Columbia University in 1915, with the degree of electrical engineer, Mr. Blanchard served as an officer in the U. S. Navy and worked for some time in the machinery field before becoming a business paper editor.

In the 17 years since he first joined the Chilton Co., Mr. Blanchard has made his influence felt and his analytical abilities effective in every part of the automotive field. As editor of *Commercial Car Journal* he became familiar with transportation and maintenance problems and participated widely in SAE activities along these lines. Later, he was editor of *Automotive Industries* and contacted intimately automotive design and production problems from the standpoint of the manufacturer. Finally, as editor of *Automobile Trade Journal*, the position from which he has just resigned, he has been a vital factor in helping automobile dealers with their merchandising and legislative problems.

Mr. Blanchard is a full member of the SAE and is vice-chairman of its Philadelphia Section. He is a brother of Harold F. Blanchard, technical editor of *Motor*, who is also a member of the Society.

Donald Blanchard

SAE members were guests of the Chicago Automobile Trade Association on a trip through Chicago's 37th Automobile Show.

This is the second time in two years that Mr. Wolf has addressed the Chicago Section during automobile show week. In his review of the 1937 models he spoke from slides, making comments on this year's engineering developments. The subject matter was similar to that in his paper, "Trends in 1937 Car Design," published in the November, 1936, issue of the SAE JOURNAL.

Preceding Mr. Wolf's talk Edward F. Lowe, assistant general manager of the Society, spoke of the accelerated growth in SAE membership and stressed the desire of the Society to develop interest among engineering students attending universities and colleges with a view of building up student membership.

Hypoid Paper Excites Prolonged Discussion

• Pittsburgh

Rear-axle design within the next two years will be so completely changed over to the hypoid design as to leave the spiral-bevel type virtually obsolete, Walter R. Griswold, Packard Motor Car Co. chief research engineer, told 140 members and guests of the Pittsburgh Section, Nov. 17.

The Packard engineer explained that hypoid gears are superseding the older spiral bevel form because of the inherently greater capacity of the hypoid form of gearing, which permits a much greater ratio of tooth strength to ring-gear diameter, thus avoiding rupture of gear teeth by fatigue due to high bending stresses of the gear teeth. Another reason for the growing adoption of hypoid gears, he said, is that they permit lowering bodies, seats, and floor boards without the use of obnoxious tunnels in the rear passenger compartment. Continuing, he explained that these gears are inherently much easier to manufacture to a high standard of quietness in operation. Hypoid gears are also being adopted because continued increases in power overloaded the spiral-bevel types and brought on skin distress which could not be prevented entirely by extreme measures in lubrication, he added.

In the introduction of his paper, "Rear-Axle Design and Lubrication," Mr. Griswold pointed out that Packard is the oldest manufacturer of hypoid axles, having introduced this type of drive in regular production in the fall of 1924, and having produced them in all Packard cars since that time.

The important relationship of the rigidity in the mounting of the gears with their size and capacity was explained by Mr. Griswold, and he laid considerable emphasis on the fact that in axles generally – and particularly with those using hypoid gears – the lubricant becomes an element tantamount to an added structural element in the axle design. He demonstrated how, by strengthening or weakening this structural element, the axle capacity increases or decreases just as would some metallic part in the unit change the capacity as it was made stronger or weaker.

The discussion of Mr. Griswold's paper, under the direction of Chairman Stephen Johnson, Jr., of Bendix Westinghouse, showed the great interest which the oil research scientists and lubricating engineers have in the subject. Chairman Johnson permitted the meeting to extend over the usual time limit as such well-known engineers as Dr. W. A. Gruse, in charge of petroleum research at Mellon Institute, Dr. Kennedy of Gulf Research and Development Laboratories, P. M. Robinson of Pennzoil Co., Mr. Saylor of Valvoline Oil Co., C. J. Livingston of the Mellon Institute, B. H. Eaton, Motor Vehicle Supervisor of the Bell Telephone Co., Mr. Lund of the American Oil Co., of Baltimore, and many others entered into the discussion. Ernest Wooler, chief engineer of Timken Roller Bearing Co., also aided in the discussion and F. A. Lundgren, Pittsburgh Packard service manager, spoke on some of the service aspects of lubrication of hypoids.

Chairman Johnson feels somewhat elated over the growing activity of the Pittsburgh Section and over the fact that the meeting was the largest they have had to date.

Aircraft Instruments Explained to Students

• N. Y. U.

Student branch members of the SAE and the American Society of Mechanical Engineers (Aero) at New York University heard Lieut. Donald W. Harmon, sales engineer, Pioneer Instrument Co., speak on the history of aeronautical instruments and explain their functions at a joint smoker held Nov. 24. He illustrated his talk with some 60 pictures which were projected on the screen.

Depicts SAE's Part in Advancing the Industry

● Milwaukee

More than 150 members and guests turned out to welcome SAE President Ralph R. Teetor and Assistant General Manager Edward F. Lowe to the Dec. 11 meeting of the Milwaukee Section. Mr. Teetor, when introduced by Section Chairman Arthur W. Pope, Jr., pictured the important role which the SAE is playing in the march of automotive progress. He traced the industry's history from the good old days of the horseless carriage up to the present, and made some predictions of what is to come.

Mr. Lowe presented the paper, "Keeping the Automotive Industry Young", which was prepared jointly by Mr. Teetor and SAE General Manager John A. C. Warner. Mr. Warner had expected to attend, but was unable to do so.

During the informal discussion which followed, the principal subject was engineering education and the fitness of young graduates for the tasks that confront them when they enter the automotive industry. It was generally agreed that the industry is so complex and so filled with problems to be solved that no young engineer with initiative need fear that there is nothing left for him to do.

Meeting on 1937 Cars Features Lubrication

● No. California

Commenting favorably on the work which has been done to reduce oil consumption at high speeds through improved piston-ring design, elimination of ring chatter and closer fitting of parts, G. L. Neely, research engineer, Standard Oil Co. of California, spoke on the lubrication trends in 1937 cars before 135 members and guests of the Northern California Section, Dec. 8. John F. Winchester, manager, general automotive department, Standard Oil Co. of New Jersey, and past-chairman of the SAE Metropolitan Section, addressed the meeting on "The Lubrication and Transportation Riddle for 1937." Prof. A. B. Domonoske presided and also presented a paper in which he compared the design trends of American and foreign makes of cars. The theme of the meeting was "New Car Features."

Laying stress on the fact that decreased capacity for transmission lubricants places an additional load upon the lubricants, Mr. Neely gave reasons behind recommendations of non-extreme-pressure lubricants for transmission overdrives. He also explained why extreme-pressure lubricants are required in steering gears with high gear reduction to permit easy steering and to diminish wheel fight. Mr. Neely, in speaking of hypoid gears, pointed out that reasons beyond the elimination of the propeller-shaft tunnels are influencing the use of these gears. Their greater strength, he said, will soon result in further decrease in size and resultant increase in lubrication problems.

We are on the threshold of radical design changes which will call upon the petroleum refiner to know much concerning chemical reaction of lubricants with metals and regarding what portions of the petroleum should be removed and what materials added to produce the perfect lubricant, Mr. Neely said in concluding his paper.

Professor Domonoske, the second speaker, discussed and illustrated with lantern slides the outstanding design trends in foreign cars and a few American cars. He also quoted some figures, compiled by section members, showing performance characteristics of six low-priced 1937 American cars, including data on air-to-fuel ratio, combustion efficiency, speedometer accuracy, fuel consumption, acceleration, hill-climbing ability, body dimensions and car weight.

The final speaker, Mr. Winchester, after introducing his paper by recalling the early days when there were 420 manufacturers of automobiles and a good car could be depended upon to travel a hundred miles or so without needing a major repair, spoke on lubrication problems, the outstanding features of the new cars and the problems facing the motor-transport industry as they are affected by existing and pending legislation.

Stating that 90 per cent of the 1937 cars should use E-P lubricants and that 60 per cent must use them, he explained that the use of ordinary lubricants with hypoid gears results in severe damage to the gears because the lubricants cannot withstand the tremendous pressure built up by the combined sliding and rolling action of the teeth. He went on to say that an E-P lubricant is compounded to chemically anchor its film on the gear surfaces so that it can withstand the pressures. Because many E-P lubricants are not suitable for hypoid

gears, Mr. Winchester stated, some car manufacturers are marketing an approved lubricant under their own names; others are listing those they approve and still others are announcing specifications of lubricants for use in their cars.

On the subject of legislation Mr. Winchester stated his opinions of certain existing laws and urged men affiliated with the automotive industry to work as individuals for sound legislation by becoming actively interested in the problems. He spoke particularly of motor-truck chassis rating and taxation.

Reports Automotive Progress in Japan

● Detroit

Today there are about 70,000 passenger cars and 40,000 trucks in use in Japan, 90 per cent of which are American products, according to Shotaro Otake from Yokahama, Japan, who addressed the Junior-Student activity of the Detroit Section on Nov. 17. The first automobile appeared in Japan about 15 years ago. Today about 95 per cent of all passenger cars are taxicabs, which are kept running day and night. Rates are approximately 15 cents for six miles, according to Mr. Otake. Roads are fairly well paved in the cities but are narrow and bumpy outside. Mr. Otake reported that the government has appropriated 1,400,000,000 yen for future highway development.

Japan has several limitations in building up its automobile production, Mr. Otake stated, adding that it lacks technicians, experience, and materials. Coal and mineral resources are lacking, he said, and the country must depend upon foreign sources of supply. According to Mr. Otake, Japan is at present producing 800 cars per month and is employing 2500 workers in the industry. Last month the industry showed a profit for the first time, he added. The problems of technicians and experience, he continued, are largely being solved through employment of American engineers who are being sent to Japan.

At the same meeting Tom O. Richards, chairman of the technical data department of General Motors Research Corp., spoke on some of the possibilities of engineering from the vocational point of view. He quoted a report published by the Commissioner of Labor in 1886 which indicated that all that was strictly necessary had been done, the day of large profits was past, and there was nothing more to do. Mr. Richards went on to point out the tremendous strides that have taken place which began that very year when a method of alloying steels was first discovered in England. Mr. Richards' philosophy as given to student engineers was summed up thus:

"Don't be too sure that you know the latest way everything is being done. Be sure you know the fundamentals of mechanics and physics, as you can learn about the other requirements of a job after you get it. It is impossible for engineering colleges to keep up with the latest practices since engineering departments are at least a year ahead of the annual shows from which most design trends are gathered. As industry's products become more technical, the fellow with engineering education will be in greater demand to fit into the scheme of things."

Sees Many Problems in Tourist-Trailer Field

● Philadelphia

Philip H. Smith, contributing editor on tourist trailers, *Automotive Industries,* declared before the Philadelphia Section at the Dec. 9 meeting that the passenger-trailer industry has yet to find itself and until it does it is hard to rate the importance of this phase of the automotive industry. Continuing on this theme Mr. Smith said that the trailer manufacturers have not yet decided whether they are building a home or a vacation vehicle.

The impetus of this new branch of the industry, according to Mr. Smith, has come because of the vehicle's ability to remove its owner from disagreeable ties, such as unemployment, and because we have become conditioned to look for a new industry that will solve such problems as general inertia and idle factory space.

There are several manufacturing and design controversies raging in the trailer field, he added, stating that the first one is on panel material. Some of the designers insist that metal panels are the answer while composition panels have many adherents, he continued. Another difference of opinion, he said, is one of overall design; some designing streamlining for appearance and others building box-type

trailers to get full headroom. He went on to say that trailer hitches are important and require a great deal of development work.

Weight on the drawbar has not been advertised accurately and the weights usually run higher than indicated, Mr. Smith declared. The effect on the tow vehicles has not been determined, he said, but some trouble is expected and it may be that some cars will be designed to have good trailer-towing qualities. Enough experience has been compiled to show that there is a decided problem relative to tow cars, he added.

The discussion led by Mr. Fitzpatrick, Pierce-Arrow Motor Car Co. brought forth many humorous aspects of the new mode of trailer living.

Meeting Devoted to Air and Land Safety

● Washington

Five out of nine major aircraft accidents in the past five years have been due to flying at too low an altitude in bad weather, Col. Harold E. Hartney, technical adviser, Senate Safety Committee on Aeronautics, told 65 members and guests at the Washington Sections meeting on "Greater Safety for Automotive Land and Air Transport", Dec. 8. Sharing the program with Colonel Hartney were Burton W. Marsh, director of safety and traffic engineering, American Automobile Association, who spoke on the development of safety courses in high schools, and H. H. Allen, who discussed the safety regulations proposed by the safety section of the Bureau of Motor Carriers, Interstate Commerce Commission.

Colonel Hartney said, in continuing, that improved equipment for planes, airports and airways have greatly reduced the probability of accidents, and he predicted that not more than three major accidents will take place during the next three years of scheduled flying, in spite of rapidly increasing air service. Colonel Hartney went on to say that American equipment for getting planes safely from one airport to another is not only more complete, but also superior to that in use on European airways. He suggested that to further improve safety the Government should stick to its job and the airlines to theirs; that the policy of non-interfering inspection be continued and improved; that the technical factor in equipment be further built up.

He added that every factor having to do with engine improvements or the further development of blind flying will add to the safety of aviation and should be encouraged. Flying, he believes, is becoming so much a matter of routine and precision that pilots need no longer fear the bogey of "I am getting too old", but that they will continue in harness until they retire the same as railroad engineers do. Comparing the railroads to the airlines, Colonel Hartney noted that it took the railroads 100 years to adopt block signals and double tracks, while aviation has made comparable progress in 33 years. He added that aviation's toll in accidents has been far less than that of the railroads in their early years, stating, as a specific example, that in one month of 1888, in one state, the employees killed and injured totaled 391.

The mortality rate of boys and girls of high school age, due to motor vehicle accidents, is growing higher while that of younger children is decreasing, said Mr. Marsh in explaining the necessity of automotive safety courses in high schools. More than 2500 high schools, he said, are now offering safety courses carefully developed by safety engineers and then adapted to presentation by educators and psychologists. The keynote of these courses is an appeal to the student's sportsmanship, rather than a specific appeal for safety, he added.

Mr. Marsh stated that too many people are prone to blame accidents on one specific thing, either legislation, enforcement, traffic signals or something else. He made it clear that no one thing can be a cure-all, although there are many things that can be improved, each of which would contribute to improving the general safety picture.

Mr. Marsh also told how the American Automobile Association is assisting in driver training courses wherein students are first instructed and then given training on the road in cars having dual control, that is, two sets of brake and clutch pedals. So far, he said, all students who have completed this course have a clear record.

Mr. Allen went over the proposed safety regulations upon which the safety section of the Bureau of Motor Carriers has been working, and asked for criticism and suggestions concerning them. These regulations, he said, thus far cover only such essential factors as head-

lights, side lights, clearance lights, rear lights, reflectors, stop lights, brakes, windshield wipers, flares and red signals.

The bureau, he explained, has divided the problem into three parts: the control of the driver, the control of the vehicle and the reporting of accidents. Hearings, he reported, are about to start on the hours of service for bus and truck drivers.

Present and Future Car Trends Discussed

• Dayton

"The Trend of Passenger Car Design for 1937 – And Future Trends," was the subject of a talk by Joseph Geschelin before 175 members and guests of the Dayton Section on Nov. 23. Mr. Geschelin, who is Detroit technical editor, Chilton publications, spoke particularly on the strides toward greater safety and comfort and remarked that many of the so-called refinements are genuine developments resulting in better vehicles.

Hypoid gears, superchargers, and economy without sacrifice of performance were the subjects of a spirited discussion which followed Mr. Geschelin's talk.

The Dayton Section's December meeting was postponed because of the speaker's illness.

Tells How Aircraft Weight May Be Reduced

• Detroit

Although lightness is a supreme requirement for aircraft structure, aerodynamic and other requirements prohibit the designer from using the most ordinary and direct means of obtaining lightness, R. H. Upson, aeronautical engineer, University of Michigan, stated before the Dec. 14 meeting of the Detroit Section, devoted to airplane and passenger car design problems. Severely limited in depth-span ratio, and with outside braces now entirely banned, weight reduction depends on certain expedients, largely refinements of detail, which Mr. Upson outlined as follows:

1. Accurate control and knowledge of the magnitude and distribution of all critical combinations of applied forces.
2. More precise and reliable stress analyses.
3. Improved materials and fasteners.
4. Forces balanced against each other in the most direct way.
5. Parts serving as many different purposes as possible.
6. Reactions carried in tension rather than compression, where possible.
7. Concentration of compressive stresses into relatively few members of most efficient section.
8. Compression members with as nearly continuous support as possible.
9. Protection against corrosion, wear, flutter and fatigue.
10. Reduction of wing area.

The use of metal apparently favors a majority of the above objects, and Mr. Upson thinks that in spite of a few quite plausible arguments for fabric covering on both airplanes and airships, the all-metal job is obviously here to stay. By this is meant the use of a smooth, stressed skin, structurally combined with a metal frame.

Remarking that there are two different and somewhat divergent trends now noticeable in this type of construction, Mr. Upson asked, "Shall we seek the benefit of an appreciable amount of skin compression by greatly extending or multiplying the compression flanges; or shall we seek the alternative benefit of fewer, more substantial, and more efficient compression flanges, leaving the skin to carry tensile stresses only?"

Evidently the final answer must be a compromise aimed at a more effective combination with other desirable refinements of structure, according to Mr. Upson. This question, he said, was settled in the Metalclad ZMC-2 dirigible by superimposing tensile stresses to balance a large part of the skin compression, which permitted unstiffened sections of skin as wide as 7 ft. A similar possibility in airplane construction has not yet been utilized, he added.

He listed specific avenues of improvement still open, and falling into the general classification already mentioned, as:

1. Boundary layer control and improved braking facilities permitting a higher wing loading.
2. Utilization of springs and shock-absorbers to reduce gust loads.
3. More precise knowledge of fatigue effects.
4. More complete analysis of the optimum type and distribution of compression flanges and shear webs.
5. Basing stress analysis on actual air pressures, inside and out, instead of on the highly arbitrary integrations of such forces still in vogue.
6. Increased practical data on pressure distribution, especially in gusts.
7. Development of practical means for the superposition of tensile stresses, mechanically and aerodynamically.
8. Improvement of joints through more efficient fastenings.

The last item, more than any other, according to Mr. Upson, also involves the matter of cost, hitherto unmentioned not from any wish to follow aeronautical tradition in that respect, but to emphasize its large and growing importance.

First cost is important enough for an airliner covering thousands of miles in a single day and millions of miles in its total life; but it is a paramount consideration in the development of private planes, by far the biggest potential market for aircraft and still almost untouched, Mr. Upson declared.

It is the stylist (and that means the sales department) who controls, to a great extent, the construction of an automobile body, according to J. W. Greig, body engineer, Hudson Motor Car Co., who followed Mr. Upson on the same program. Each time the style is changed, the construction necessarily is adjusted to suit this new design, he said. It is because of the stylist that the designer cannot go radical in the design of construction, such as blowing up a balloon out of fibrous resin material or some other pet idea that might be had, Mr. Greig stated.

Speaking of weight saving, Mr. Greig pointed out that welding develops the ability to save weight through non-overlapping materials, the saving of bolts, nuts and rivets. It was, he said, through welding development that we now have one-piece roofs and back panels without excessive weight and waste. Mr. Greig also pointed out that a reduction in cost can actually be made with each pound of weight saved in most cases.

The body shell of the present car is skin stressed and designed for it, Mr. Greig maintained. He pointed out that thin metals, at their point of attachment, will eventually fatigue at the joint unless the area is great enough. He suggested that one way to offset this is to spot-weld a piece of heavier gage material to the thin material at its point of contact with structural members. The forming operation of the part, he continued, can be made with these heavier materials welded in place and in this way it is possible to eliminate many smaller stampings and the dies necessary to make them.

Mr. Greig gave a typical breakdown of weights as we find them in a hypothetical 3000-lb. car: Chassis weight is about 1500 lb. and body weight approximately 900 lb. Of the chassis, 300 lb. is the weight of frame, and of the body 300 lb. is the body shell structure, minus all doors. This gives the

(Continued on page 36)

Annual Meeting Exhibitors

AN engineering exhibit for engineers, in charge of engineers, will be held Jan. 11 to 15 in the Book-Cadillac Hotel, Detroit, as one of the features of the SAE Annual Meeting. A partial list of exhibitors appears below, in alphabetical order. Visit the exhibits when you attend the Annual Meeting.

Acheson Colloids Corp.
Air Reduction Sales Co.
Aluminum Co. of America
Aluminum Industries, Inc.
Burgess Battery Co.
Campbell, Wyant & Cannon Foundry Co.
Cities Service Co.
Cleveland Graphite Bronze Co.
Continental-Diamond Fibre Co.
Deluxe Products Corp.
Doehler Die Casting Co.
Dole Valve Co.
E. I. du Pont de Nemours & Co., Inc.
Fleming Manufacturing Co., Inc.
Ford Motor Co.
Hercules Motors Corp.
International Nickel Co.
Koppers Co.
Monroe Auto Equipment Co.
Motor Improvements, Inc.
Parker-Kalon Corp.
Sun Oil Co.
Sunnen Products Co.
Spicer Manufacturing Corp.
Timken Roller Bearing Co.
United American Bosch Corp.
Victor Manufacturing & Gasket Co.
Waukesha Motor Co.
S. S. White Dental Manufacturing Co.
Wilson Welder & Metals Co.
Wilson Mechanical Instrument Co.

(Continued from page 34)

structural unit of the car a weight of approximately 600 lb. Doors weigh 255 lb. and seats, 175 lb. The glass has a total weight of 55 lb. and other trim and incidentals such as carpet, cloth, cardboard, insulation, hardware, etc., make up the rest, about 170 lb. The body shell, as it is being used today, weighs 200 lb. Even with all the welding being done, there are 35 lb. of bolts, nuts and rivets still being used, according to Mr. Greig. The sheet metal such as hood, radiator shell and fenders (which have no structural bearing whatever, but are merely used to cover objectionable parts and give a smooth appearance) weighs 181 lb., he added.

Some opportunities for weight reduction listed by Mr. Greig included substitution of plastic material for glass; development of stamping, material and design in doors; elimination of sheet metal with the help of the stylist; and modification of seats.

Service Men Speak At Closed Meeting

• Oregon

The Oregon Section termed its second closed meeting of the year "Service Superintendents' Evening". It was held Dec. 11 and only members and a few invited guests attended. Chairman VandeWater presided.

Realizing that nothing said would be reported the speakers literally tore the new cars apart and put them together again, emphasizing strong points and criticizing weak ones. The speakers included D. L. McGregor on Hudson, Terraplane and Willys, O. A. Struss on Chevrolet, R. W. Vinson on Nash and Lafayette, and E. H. Swayze on Studebaker.

Questions from the November Question Box were freely discussed and several new problems were submitted for January. W. H. Paul told of student activities at Oregon State College and it was announced that J. Verne Savage would attend the SAE Annual Meeting in Detroit, Jan. 11-15.

About Authors

(Continued from page 11)

tory at first, then had laboratories at Harvard University and later, in 1932, established the Land-Wheelwright Laboratories with George Wheelwright, III. He has devoted his time to the study of the basic phenomena of polarization and in the development of new applications of Polaroid in addition to the major project, headlight glare elimination.

• **Erle Martin** *received his B.S. degree from Pennsylvania State College. After serving with the Fairchild Aircraft Co. and later with Air Propellers, Inc., he joined the Hamilton Standard Propellers organization of which he is now chief engineer.*

• **Russell Hudson McCarroll** *was but one year out of the University of Michigan, where he was graduated in chemical engineering, when he entered the employ of the Ford Motor Co. in 1915. After special work in coke oven installation at the new Rouge plant in 1919 he began specializing in metallurgy. He developed exclusive alloys and heat treatments which made possible the use of castings for such parts as crankshafts, camshafts and pistons, that are stronger, yet lighter than conventional castings, and that cost less to build. He also supervised experiments resulting in development of synthetic lacquer from soy beans, now used to finish Ford cars. He supervises 20 laboratories developing and testing new materials and uses, and now is devoting special attention to widen the use of farm-produced materials in industry.*

• **A. D. Meals** *went into the machine tool industry immediately after graduating from Purdue University in 1914. For the past 12 years he has been connected with the Cincinnati Milling Machine and Cincinnati Grinders, Inc., where he is now sales engineer. Earlier he was affiliated with the Warner & Swasey Co. and the Foster Machine Co. He has specialized in development and sales of both centerless and centertype grinders. During the World War Mr. Meals was engineering officer in the U. S. Naval Reserve Corps, with the commission of ensign.*

• **Thomas B. Rhines** *joined the United Aircraft Research Division immediately upon graduating from M.I.T., where he received his B.S. degree. He is aeronautical engineer of that organization.*

• **A. M. Rothrock** *graduated from Pennsylvania State College with a B.S. in physics in 1925. He continued at Penn State as graduate assistant until 1926 when he received his appointment to the Langley Memorial Aeronautical Laboratory of the National Advisory Committee for Aeronautics. As a member of the technical staff he has been conducting research on fuel injection and combustion phenomena in Diesel engines since that time. His present rating is head, fuel injection section. Mr. Rothrock is a member of the Institute of the Aeronautical Sciences, Sigma Xi, and the N.A.C.A. Subcommittee on Aircraft Fuels and Lubricants.*

• **Norman G. Shidle** *has been in automotive publishing since 1920. For 13 years he was with the Chilton Company, first on "Automotive Industries" and later as directing editor of all that organization's automotive papers. He was a member of the SAE Council in 1932-1933 and was chairman of the Philadelphia Section in 1927-1928. Since 1933 he has been executive editor of the SAE Journal and has contributed regularly to "Forbes" as automotive editor. He was graduated from Swarthmore College in 1917 and was on the editorial staff of the Ronald Press Co., New York, before entering the automotive field.*

SAE Meetings Calendar

Annual Meeting

(See pages 17-19)

Tractor Meeting

April 21-23, 1937
Pere Marquette Hotel
Peoria, Ill.

Buffalo—No meeting

Canadian—Jan. 20
Royal York Hotel, Toronto; dinner 7:00 P. M. Speaker—Laurence P. Saunders, director of engineering, Harrison Radiator Corp.

Chicago—Jan. 5
Hamilton Club; dinner 6:30 P. M. The Place of Research in the Evolution of the Automobile—T. A. Boyd, head of Fuel Section, General Motors Corp.

Cleveland—No meeting

Dayton—Jan. 18
Engineers Club; dinner 6:30 P. M. Trailers—William B. Stout, president, Stout Engineering Laboratories, Inc.

Detroit—Jan. 11 to 15
Book-Cadillac Hotel; participation in Annual Meeting of the Society.

Indiana—Jan. 14
The Athenaeum, Indianapolis; dinner 6:30 P. M.

Kansas City—Jan. 19
Hotel Kansas Citian; dinner 6:30 P. M. Speakers—George A. Page, Jr., chief engineer, Curtiss-Wright Airplane Co., and a representative from Transcontinental and Western Air, Inc.

Metropolitan—Jan. 18
The Roger Smith, 40 E. 41st St., New York City; dinner 6:30 P. M. Aviation Engine Development—Henry C. Hill, project engineer, Wright Aeronautical Corp. Additional talks will be given by: a representative of Pratt & Whitney Aircraft Co., on engines; a representative of the Maybach Co. or the Junkers Co., on Diesel engines, and a representative of Eclipse Aviation Corp., on accessories.

Milwaukee—No meeting

New England—Jan. 12
Walker Memorial, M.I.T., Cambridge, Mass.; dinner 6:30 P. M. Hypoid Gears—Design, Service and Lubrication—John H. Baird, engineering dept., Lubri-Zol Corp.

Northern California—Jan. 12
Engineers Club, San Francisco; dinner 6:30 P. M.
(The Section will hold its Annual Dinner Dance on February 6.)

Northwest—Jan. 15
Roosevelt Hotel, Seattle; dinner 6:30 P. M. Automotive Engineering Progress—George E. Bock, design engineer, tractor equipment, Isaacson Iron Works; Harley W. Drake, superintendent of equipment, Pacific Highway Transport Co., and W. W. Churchill, superintendent of equipment, Washington Motor Coach Co.

Oregon—Jan. 15
Imperial Hotel, Portland; dinner 6:30 P. M. 1937 Trend in Truck Design and Current Developments in Equipment—Frank C. Allen, Motor Truck Branch, International Harvester Co., Joseph P. Seghers, president and manager, Seghers Motor Co.; Ed Dagner, branch manager, White Motor Co., and Robert Mann, manager, Isaacson Iron Works.

Philadelphia—Jan. 20
Engineers Club; dinner 6:30 P. M.

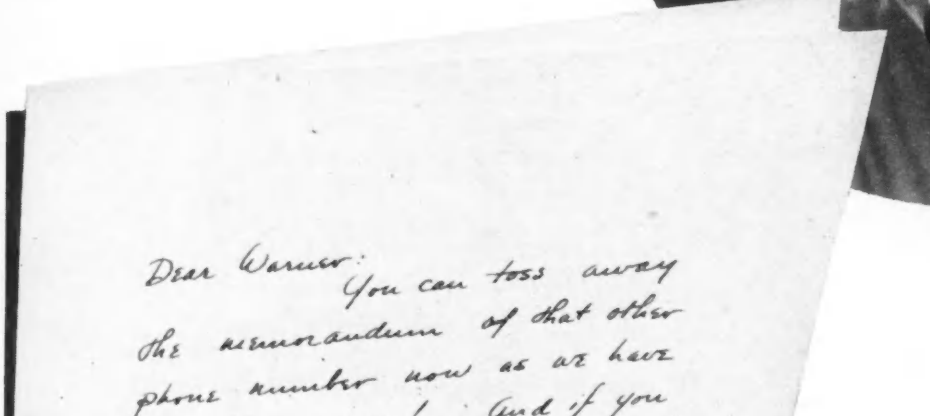
St. Louis—No meeting

Southern New England—Jan. 19
Bond Hotel, Hartford, Conn.; dinner 6:30 P. M. New Designs in Aircraft—I. I. Sikorsky, vice-president in charge of engineering, Sikorsky Aircraft Division, United Aircraft Corp.

Southern California—Jan. 29
Barker Bros. Emporium, Los Angeles; dinner 6:30 P. M. Fuels—Now and in the Future—Dr. U. B. Bray, assistant manager of research, Union Oil Co. of Calif.

Washington—No meeting

A Happy New Year for *Kathryn*



Dear Warner:
You can toss away the memorandum of that other phone number now as we have one of our own! And if you don't think I feel swell about it, you're not the smart brother I think you are. I get a kick every time I pass that telephone in the living room.

Kathryn

The number is Exchange 2376.

THAT'S a real letter—written by a real Kathryn—to her brother. You can read her happiness in every line. She's mighty glad to have the telephone back.

And so are a great many other men and women these days. About 850,000 new telephones have been installed in the past year.

That means more than just having a telephone within reach. It means keeping the family circle unbroken—contacts with people—gaiety, solace, friendship. It means greater comfort, security; quick aid in emergency.

Whether it be the grand house on the hill or the cottage in the valley, there's more happiness for everybody when there's a telephone in the home.

The Bell System employs more men and women than any other business organization in the United States. The total is now close to 300,000. Good business for the telephone company is a sign of good business throughout the country.

BELL TELEPHONE SYSTEM

Notes and Reviews

THESE items, which are prepared by the Research Department, give brief descriptions of technical books and articles on automotive subjects. As a rule no attempt is made to give an exhaustive review, the purpose being to indicate what of special interest to the automotive industry has been published.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

AIRCRAFT

Engineering Aerodynamics

By Walter Stuart Diehl. Published by The Ronald Press Co., New York, Revised Edition, 1936; 556 pp., illustrated. [A-1]

This volume represents a complete revision of the original edition published in 1928 and includes new material made available through intensive aerodynamic research on the part of various laboratories and active experimental construction on the part of the airplane manufacturers since that time.

The book gives new data and methods on applied wing theory, control surface design, performance calculation and estimation.

Practical Aircraft Stress Analysis

By D. R. Adams. Published by Pitman Publishing Corp., New York and London, 1936; 163 pp., illustrated. [A-1]

The subject matter of this book, based on lectures delivered at the de Havilland Aeronautical Technical School by the author, is presented with the object of providing a simple and practical study of the methods used in the stress analysis of aircraft components.

The Airplane and Its Engine

By C. H. Chatfield, C. Fayette Taylor and Shatswell Ober. Published by McGraw-Hill Book Company, Inc., New York and London, Third Edition, 1936; 401 pp., illustrated. [A-1]

Intended primarily for the reader desiring a sound knowledge of the basic principles and a broad view of the present development of the airplane and its power plant, without giving to the subject the intensive study which is essential for the designing engineer or the expert mechanic, this book has found in its two previous editions, wide acceptance by both the general public and by schools and colleges.

Messrs. Chatfield and Taylor through their contributions to the Society's activities are well known to our members.

Twenty-First Annual Report of the National Advisory Committee for Aeronautics, 1935.

Published by the National Advisory Committee for Aeronautics, 1936; Available at the Government Printing Office, City of Washington; 625 pp.; Price, $2.75. [A-1]

The report of the National Advisory Committee for Aeronautics for the year 1935 includes technical reports Nos. 508 to 541, individually noted throughout the past year in these columns.

Preliminary Tests in the N.A.C.A. Free-Spinning Wind Tunnel

By C. H. Zimmerman. N.A.C.A. Report No. 557, 1936; 18 pp., illustrated. Price, 10 cents. [A-1]

Turbulence Factors of N.A.C.A. Wind Tunnels as Determined by Sphere Tests

By Robert C. Platt. N.A.C.A. Report No. 558, 1936; 21 pp., with tables and charts. Price, 10 cents. [A-1]

The Forces and Moments Acting on Parts of the XN2Y-1 Airplane During Spins

By N. F. Scudder. N.A.C.A. Report No. 559, 1936; 8 pp., with tables and charts. Price, 5 cents. [A-1]

A Simplified Application of the Method of Operators to the Calculation of Disturbed Motions of an Airplane

By Robert T. Jones. N.A.C.A. Report No. 560, 1936; 13 pp., with charts. Price, 10 cents. [A-1]

Calculated and Measured Pressure Distributions Over the Midspan Section of the N.A.C.A. 4412 Airfoil

By Robert M. Pinkerton. N.A.C.A. Report No. 563, 1936; 16 pp., illustrated. Price, 10 cents. [A-1]

Ground-Handling forces on a 1/40-Scale Model of the U. S. Airship "Akron"

By Abe Silverstein and B. G. Gulick. N.A.C.A. Report No. 566, 1936; 14 pp., illustrated. Price, 10 cents. [A-1]

Airplane Design—Performance

By Edward P. Warner. Published by McGraw-Hill Book Co., Inc., New York, Second Edition, 1936; 653 pp., illustrated. [A-1]

What started as a revision of his book on the Aerodynamics of Airplane Design published nine years ago, the author explains, grew into a complete rewriting and subdivision of the material into two volumes. This, the first volume, treats of performance alone and the basic aerodynamic laws and phenomena and collected data which control performance.

Stability and control will follow in another volume.

Mr. Warner, a past-president of the Society and identified with many of its activities, needs no introduction to the JOURNAL readers.

The Nature of the Deflection-Aileron Flutter of a Wing as Revealed through its Vibrational Frequencies

By Katsutada Sezawa and Satosi Kubo. Report No. 140 of the Aeronautical Research Institute, Tokyo Imperial University, June, 1936; 42 pp., illustrated. [A-1]

Chief Characteristics and Advantages of Tailless Airplanes

By A. Dufaure De Lajarte. Translated from *Association Technique Maritime et Aeronautique*, June, 1935. N.A.C.A. Technical Memorandum No. 794, May, 1936; 39 pp., 8 figs. [A-1]

Similitude in Hydrodynamic Tests Involving Planing

By M. F. Gurson. Presented on the occasion of the inauguration of the Institute of Mechanics of Fluids of the University of Lille, April 5-8, 1934. N.A.C.A. Technical Memorandum No. 795, May, 1936; 6 pp., 2 figs. [A-1]

Étude du Confort à Bord des Avions de Transport et Application Pratique à un Appareil

By Stephen J. Zand and Gilbert Perot. Published in *L'Aéronautique*, June, 1936, *L'Aérotechnique* section, p. 69. [A-1]

The authors have for three months been in the service of the French government, engaged in introducing to the French aircraft industry methods of reducing noise and increasing passenger comfort in use in this Country. The present article summarizes their work, dealing with it under five headings: noise study in aircraft; elastic engine mounting; heating and ventilation; soundproofing material; a concrete case of soundproofing, the Breguet-Wibault 670.

Die "Spannziffer" eines Zugstabes mit Abgestufter Biegesteifigkeit

By Hans W. Kaul. Published in *Luftfahrt-Forschung*, June 20, 1936, p. 181. [A-1]

In this theoretical discussion of the tension coefficient in a tension member with graduated resistance to bending, the Von Kármán method of calculation is applied to a tension member stressed beyond the elastic limit. As in welded structures members are often stressed beyond their elastic limit over only part of their length, determinations are made of the effect of the extent of such stressed portion and its location within the member.

Flugzeug-Typenbuch 1936

By Helmut Schneider. Published by Herm. Beyer Verlag, Leipzig, Germany. 300 pp.; illustrated. [A-1]

This first handbook of the German aircraft industry contains specifications and performance data on powered and glider aircraft and aircraft engines; information on parts, accessories, instruments, testing machines, structural materials and machine tools; and a manufacturers' index.

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NOTES AND REVIEWS

Continued

Recherches sur un Nouveau Type d'Appareil Volant: l'"Hélicoplan"

By Lado-Bordowsky. Published in *L'Aéronautique,* July, 1936, *L'Aérotechnique* section, p. 89. [A-1]

The new type of airplane described is said to have the following advantages: for the same lift area, a reduction of 65 per cent in take-off and landing speed; and for the same take-off or landing speed, the possibility of doubling or even tripling total weight.

These advantages are said to be due to the two lift propellers, which are inoperative during normal flight. They revolve in opposite directions, parallel to the wing surface, and are placed symmetrically with relation to the longitudinal axis of the airplane.

Un Aspect Particulier de la Lutte Contre le Bruit: l'Insonorisation des avions

By A. Métral. Published in *Le Génie Civil,* July 25, p. 79 and Aug. 1, 1936, p. 97. [A-1]

An exhaust silencer operating on a new principle and designed by the French engineer Coanda is described in this article on decreasing airplane noise, in the section dealing with the diminution of the source of noise. Methods of decreasing gear and propeller noise are also discussed in this section.

Properties of sound absorbing and insulating materials, as well as some results obtained are included in the section dealing with the sound-proofing of cabins.

Introducing the practical details is a theoretical discussion of the nature of noise, the intensity and audibility of sound, its measurement and propagation. In conclusion, the complexity of the problem of noise suppression in airplanes is stressed and the specialization of engineers in this field urged.

Les Hélices à Pas Variable à Commande Électrique

By J. Richarme. Published in *La Technique Moderne,* Aug. 15, 1936, p. 569. [A-1]

After setting forth the conditions required for the most advantageous operation of the propeller, the author examines in detail the present achievements in the field of electrical control of variable-pitch propellers.

He concludes that in spite of the complexity of the mechanism, electrical control of variable-pitch propellers is a relatively easy solution of the problem of propeller control. The detail design difficulties, due to the application of an electric transmission to a revolving system, are said to be outweighed by the advantages obtained of a continuous variation of pitch, exactness of adjustment and maneuverability.

Windkanaluntersuchungen über den Luftwiderstand Luftgekühlter Flugmotoren mit Sternförmiger Zylinderanordnung.

By J. Kruckel. Published in *Luftfahrt-Forschung,* Aug. 20, 1936, p. 239. [A-1]

The results of an extensive investigation of the drag of air-cooled radial engines is here described. Tests were made on individual cylinders, on models of radial engines, and on several fuselages equipped with engine models and with and without propellers. The results are said to indicate design features through which drag may be considerably reduced.

Der Masstabeinfluss beim Schleppversuch mit Flugzeug-Schwimmwerken

By Rud. Schmidt. Published in *Luftfahrt-Forschung,* July 20, 1936, p. 224. [A-1]

Measurements were made of the forces and moments on a full-scale flotation gear of a flying-boat and the results compared with those of models of the same design in two different sizes, as obtained in towing tanks. The object was to determine the effect of the Reynolds number on the results of model towing tests.

Der Strahleinfluss bei Offenen Windkanalen

By F. Weinig. Published in *Luftfahrt-Forschung,* July 20, 1936, p. 210. [A-1]

An investigation was made of the effect on the results obtained of the walls in an open wind tunnel in front of and following the test section, for a circular air stream and for models whose span is small as compared with the tunnel diameter.

Die Numerische Behandlung der Gesteuerten Längsbewegung eines Flugzeuges

By J. Kleinwachter. Published in *Luftfahrt-Forschung,* May 20, 1936, p. 133. [A-4]

A simplified method for calculating the dynamic stresses imposed on

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NOTES AND REVIEWS

Continued

an aircraft by sudden changes in the angle of attack, such as caused by gusts, is developed.

Über den Einfluss der Bodenbreite eines Schwimmers oder Flugbootes auf den Landestoss

By E. Mewes. Published in *Luftfahrt-Forschung,* May 20, 1936, p. 148. [A-4]

The effect of the width of landing surface of a pontoon or flying-boat on the landing impact is theoretically discussed.

Über die Weichlötung von Stahlblechen und ihre Verwendung im Flugzeugbau

By A. Sambraus. Published in *Luftfahrt-Forschung,* June 20, 1936, p. 190. [A-5]

Tin soldering and its usage in aircraft construction is discussed and the suitability of cadmium-zinc soldering for thin-walled steel sheets is investigated.

CHASSIS PARTS

Les Freins de Ralentissement pour Automobiles

By Henri Petit. Published in *Journal de la Société des Ingénieurs de l'Automobile,* May, 1936, p. 135. [C-1]

Decelerative brakes are defined as those capable of operation for indefinite periods without modifying any vehicle parts or being themselves modified, whose object is to retard the vehicle, without the ability to bring it to a stop or to hold it immovable on a slope however slight.

Problems in connection with such brakes are discussed particularly as they are affected by the type of energy into which the kinetic energy is transformed, heat, electrical, or potential. Various design types are referred to, and two designs, the French S.A.F.E. electrical and the Westinghouse air brake are described in detail.

Kürzere Bremswege durch Erhöhung des Luftwiderstandes

By Stefan Sztatecsny. Published in *Automobiltechnische Zeitschrift,* July 25, 1936, p. 382. [C-1]

The question of more efficient braking from high speeds by means of auxiliary aerodynamic brakes is discussed from the standpoint of reliability, minimum stopping distance and economy. The advantages of a new type of compound brake are illustrated, and the conclusion is drawn that such compound brakes, utilizing the force of air resistance as well as the friction between tire and roads are of present practical interest.

Zur Schwingungslehre der Kraftfahrzeugfederung

By E. Marquard. Published in *Automobiltechnische Zeitschrift,* July 25, 1936, p. 352. [C-1]

After briefly surveying the available German technical literature on the vibration of automotive spring suspensions, the author presents a mathematical method for determining the frequencies, amplitudes and accelerations of natural vibrations of various undamped suspension systems. A critical discussion of the method leads to the conclusion that it has practical applicability. Examples of its use are given.

Untersuchungen über die Quetschöl-Verdrängung und ihre Auswirkung bei Zahnradgetrieben

By E. Heidebroed and W. Peppler. Published in *Kraftfahrtechnische Forschungsarbeiten,* No. 2, p. 1. [C-1]

An investigation is here reported of the variations in oil pressure, and their effect on oil and on gears, caused when gear teeth are alternately engaged, thereby displacing the lubricant, and withdrawn, thereby drawing in oil or air, or a mixture of the two. Conclusions are drawn with regard to the condition and stability of the oil, casing dimensions, lubrication, gear teeth dimensions and gear-cutting methods.

ENGINES

Etude sur les Vibrations des Automobiles

By Paul d'Aubarède. Published in *Journal de la Société des Ingénieurs de l'Automobile,* July-August, 1936, p. 258. [E-1]

An analysis is made of the vibrations of an automobile engine in operation. Applying this analysis practically, the author then discusses the location and design of rubber mounting blocks to damp and isolate these vibrations.

Entropy Diagrams for Combustion Gases of Gas Oil

By Keikichi Tanaka, Seiichi Awano, Toyoaki Ôhino, and Masami Kobayasi. Report No. 144 of the Aeronautical Research Institute, Tokyo Imperial University, September, 1936; 14 pp., 12 tables, 6 diagrams. [E-1]

(Concluded on page 44)

NOTES AND REVIEWS

Concluded

HIGHWAYS

The Steadyflow Traffic System

By Fritz Malcher. Published by Harvard University Press, Cambridge, Mass., 1935; 77 pp., illustrated. [F-1]

Although the principles of the steadyflow system had been published in a number of articles, largely in *The American City*, prior to the death of the author, his friends believed that the worth of the man and the value of his work demanded as consistent and complete a statement of his ideas as could be made, to take the place, as far as might be, of the comprehensive book which he had in mind at the time of his death. Accordingly, his material which was in fragmentary form, has been collected, and is published by the Harvard School of City Planning in the series of City Planning Studies as a contribution to the field of street design and traffic regulation.

The Driver

Sportsmanlike Driving Series. Published by the American Automobile Association, City of Washington, 1936; 85 pp., illustrated. [F-4]

Driver and Pedestrian Responsibilities

Sportsmanlike Driving Series. Published by the American Automobile Association, City of Washington, 1936; 77 pp., illustrated. [F-4]

These are the first two of the Sportsmanlike Driving Series of five pamphlets being prepared by the American Automobile Association for a course in traffic, safety and driving, based largely on the "Sportsmanlike Driving" outline for teachers which was prepared by the Association in 1935.

Collisions in Street and Highway Transportation

By Barry Mulligan. Published by Dorrance and Co., Inc., Philadelphia, Pa., 1936; 310 pp., illustrated. [F-4]

The object of this book is to discuss the question of street and highway safety, or what the author elects to call the "traffic problem." The elements of this problem are considered and remedies suggested.

MATERIAL

Theory of Elastic Stability

By S. Timoshenko. Published by the McGraw-Hill Book Company, Inc., New York and London, 1936; 518 pp. [G-1]

This is one of the Engineering Societies' monograph series.

The author points out that the modern use of steel and high-strength alloys in engineering structures, especially in bridges, ships and aircraft, has made elastic instability a problem of great importance and urgent practical requirements have given rise in recent years to extensive investigations, both theoretical and experimental, of the conditions governing the stability of such structural elements as bars, plates, and shells. This work, recorded in various places and languages, often difficult of access to engineers who need it for guidance in design, is brought together in this volume.

Numerous references to papers and books relating to stability problems are given in this book.

PASSENGER-CAR

Les Resultats du Concours de la Voiture S.I.A.

By Maurice Berger. Published in *Journal de la Société des Ingénieurs de l'Automobile*, July-August, 1936, p. 249. [L-1]

A brief statistical study of the 102 designs submitted in the S.I.A. competition for an economical, two-passenger car design is here presented, as a preface to the 400-page volume which will contain all the details of the applications. Among the general features used by the majority of competitors are the following: rear engine mounting, four wheels arranged in a rectangle, driving wheels at the rear, steering wheels at the front, and a two-cylinder opposed air-cooled engine.

Das Kraftfahrzeug: Betriebsgrundlagen, Berechnung, Gestaltung und Versuch

By W. Kamm. Published by Julius Springer, Berlin, Germany. 237 pp.; 484 illustrations. [L-1]

Writing a textbook on automotive design is a large and bewildering undertaking, because of the complexity of the subject and the extent of fundamental and detail research in connection with it. The author has met the problem by using as his basis the subject matter presented before his students at the Stuttgart college of engineering, setting forth a simple and comprehensive outline of the fundamentals, amply illustrated from German practice, and annotated with a carefully selected bibliography of more than 100 articles. His treatise ranges from such general topics as the arrangement of the chief parts of the automotive vehicle, to details such as octane number ratings of fuels, Diesel engine fuel pumps, and exhaust noise damping.

S·A·E JOURNAL

Published Monthly By The Society of Automotive Engineers, Inc.

Harry T. Woolson, President David Beecroft, Treasurer

John A. C. Warner, Secretary and General Manager

Norman G. Shidle, Executive Editor

Vol. 40 FEBRUARY, 1937 No. 2

CONTENTS

About Authors

• **John K. Ball**, *as chief stress engineer of the Boeing Company, has directed all stress work on recent Boeing planes, including the P-26A pursuits, the model 247-D transports, the Y1B-9A twin-engined bombers and the model 299 four-engined bombers. After attending the University of Washington, where he was trained in civil engineering, he joined Boeing as a stress engineer in 1928. He has been chief stress engineer since 1931. Mr. Ball is a native of Spokane, Wash.*

• **A. L. Beall**, *SAE's vice-president representing Aircraft-Engine Engineering for 1937, is research engineer of Wright Aeronautical, which company he joined as test engineer in 1933. Previously he was for some years in charge of quality control of internal-combustion fuels for the Vacuum Oil Co., and a member of their research committee. Before that he spent two years in the development of a single-cylinder air-cooled engine for a cycle car, and a year doing experimental work on storage batteries for the Westinghouse Union Battery Co. His first job was with the H & N Carburetor Co., following which he joined the Prest-O-Lite Co. where he devoted most of his time to applying the then infant art of acetylene welding to maintenance and production work. He was born in New York City.*

• **Edward G. Budd** *is credited with manufacturing the first all-steel automobile body. This was in 1910 when he was on the operating force of Hale & Kilburn. Two years later he formed the Edward G. Budd Manufacturing Co., financing it largely by his own savings, with the help of some local capital. Formed to exploit the new field of sheet-metal stampings, his company soon had as its principal products automobile-body stampings, and later, complete automobile bodies. About 1930 Mr. Budd became interested in the physical properties of stainless steel and, after four years of research and experimentation, his company pioneered in the development of*

(*Continued on page 27*)

Publication Office, 56th and Chestnut Sts., Philadelphia, Pa.; Editorial and Advertising Departments at the headquarters of the Society 29 West 39th St., New York, N. Y. Western Advertising Office, Room 2-136 General Motors Bldg., Detroit, Mich.

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Annual Meeting

Pours Out

IDEAS–FACTS–NEWS

On 10 trial trips, the *Hindenburg* took in $400,000; had expenses of $530,000; and "dead-heads" took up 20 per cent of passenger capacity—which is now being increased to 40 per cent.

Estimated: chances of a forced landing by a four-engined plane in crossing the Pacific are 1 in 100,000.

Trailer coach output of 75,000 is predicted for 1937.

Fact: 3 *per cent of all piston-rings are stuck in engines sent in for overhaul at the Army Corps Depot, Wright Field.*

Traffic fatality rates per 10,000 vehicles operating are—U.S.A., 13.5; England, 30.6; Scotland, 44.8; Italy, 59.4 . . . "lack of power in a motor car evidently is not the answer to the safety problem."

Claimed: Errors as large as 2 octane numbers in knock ratings might be made by using standard A.S. T.M. motor method, designed for sea-level conditions, at high altitudes.

Contended: Cost of Diesel fuel would have to increase 642 per cent in California before fuel costs of gasoline and Diesel trucks would equalize.

Described: *A new method of measuring cylinder head temperatures accurately.*

In 1901, first internal-combustion-engine-powered tractor was built. Today on American farms are 1,-248,000 such tractors.

Speeds up to 325 m.p.h. in trans-oceanic airplane routes are looked for in near future.

News: A life membership was presented to Past-President D. G. Roos at business session, Tuesday, Jan. 12.

Chips

The miscellaneous items assembled on this page are just *chips* from the technical news story of the 21 sessions of this great meeting which begins on the following page. Every SAE Journal reader will be interested in parts of it.

Never was an annual meeting of the SAE so productive of new ideas, interesting facts, spontaneous expressions of opinion and announcements of new methods and equipment.

Claimed by an insurance man: Cost of repairing cars which have been in accidents has increased 25 per cent in last 3 or 4 years.

Quote: *"Cylinder wear is in a class with religion and politics as a controversial issue"—Max Roensch.*

Opinions differ as to whether or not trailer coaches must be designed for use by passengers while in motion.

Announced: "A simple one-piece piston ring design that appears to eliminate completely piston ring-sticking tendencies regardless of what the temperature may be."

30 years ago a patent was granted for photo-electric counting of pedestrians, horses, buggies and other moving objects.

Quote: "Engineering spells civilization and must go on"—SAE President Harry T. Woolson.

Higher compression ratios and higher specific outputs without detonation are predicted for future car engines.

Just released: *Important research results on gust loading by National Advisory Committee for Aeronautics.*

Read the Whole Story—*Beginning on the next page*

Eckener Dinner Great Annual

K. T. Keller, *left*, and Dr. Hugo Eckener have a few moments' chat before taking their places at the speakers' table. Mr. Keller, Chrysler president, introduced Dr. Eckener, principal speaker, whose talk "The Airship and Its Place in Modern Transportation" was heard by 1300 attending the Annual Meeting Dinner and broadcast to countless thousands over a coast-to-coast network

Annual Meeting Statistics

Attendance: Biggest ever—over 2500 total. Individual technical sessions had as many as 500.

Committee meetings: 45.

Dates: Jan. 11-15.

Place: Book-Cadillac Hotel—Detroit.

THE airship will not have finished its usefulness even when airplanes are capable of transporting commercial loads and passengers regularly across the ocean, Dr. Hugo Eckener, chairman of the board, German Zeppelin Transport Co., said on Thursday evening at the dinner which was attended by the largest crowd ever brought together at a similar SAE occasion. Almost 1000 people were turned away after 1300 had been accommodated.

W. J. Davidson, General Motors Corp., was toastmaster, while Vincent P. Rumely, Hudson Motor Car Co. and Detroit Section chairman, welcomed the dinner guests in behalf of the Detroit Section.

K. T. Keller, president, Chrysler Corp., introduced Dr. Eckener, mentioning the fact that Dr. Eckener had been a severe critic of Count Zeppelin's endeavors before making a careful examination of the whole problem and himself becoming an exponent of this remarkable development.

Harry T. Woolson, making his inaugural address as president of the SAE for 1937, stressed the opportunities which lie ahead of the engineer today, while Ralph R. Teetor, retiring SAE president, thanked the members for the cooperation given him during his term of office and bespoke confidence in the further progress to be made under Mr. Woolson's leadership.

Vincent Bendix, with the assistance of his personal representative, Herbert L. Sharlock, presented to Louise Thaden and Blanche Noyes the Bendix trophies which they had won in the transcontinental air race last fall.

Dr. Eckener answered with a strong affirmative the question: "Will the much greater comfort and convenience offered by airship travel appeal to a sufficiently large percentage of the traveling public?" All passengers, without exception, he said, have praised the accommodations, the smooth and agreeable operation of the airship, the food and the service on the *Hindenburg*.

On its ten demonstration trips over the Atlantic last year, the *Hindenburg* amply covered 75 per cent of its total operating costs, including every possible item such as operating expenses, amortization of the ship, general administration costs, terminal expenses, etc. This it did despite the fact that 20 per cent of its passenger capacity was devoted to "dead-heads" which represented a 15 per cent loss. Total income from these ten voyages was $400,000 and total expenses, $530,000. Profitable operation will be made certain, Dr. Eckener stated, by the fact that the passenger capacity of the *Hindenburg* is now being increased by 40 per cent.

The future will see trans-oceanic mail service at low cost by steamships, at very high cost by airplane and at rates but little higher than present steamship rates by airship, Dr. Eckener predicted. An airship letter ultimately will cost about 8 cents, he believes.

Rotating hangars eventually will solve the problem of land-

Broadcast Tops SAE Meeting

ing and mooring which is now quite vexatious, he indicated, saying that a certain equivalent for the rotating hangar – which is the ideal solution – would be a landing station which offers extremely favorable meteorological conditions. Lakehurst does not provide such conditions, he stated.

Unfortunate experiences with past American "Zeppelins" are not likely to be repeated in the future, Dr. Eckener believes. He is convinced that America will take up such constructions again because the commercial practicability of such ventures has now been proved.

"It would be particularly gratifying to me," he concluded, "if out of the circle which I have the honor of addressing this evening, stimulating thought and assistance should be forthcoming."

Business Session

The Business Session of the Society held Tuesday evening was featured by the announcement of the results of the election of officers and councilors, the presentation to Past-President Roos of a life-membership certificate, and the election of three members-at-large to the Nominating Committee.

The three members-at-large elected were Walter Fishleigh, A. J. Scaife and E. P. Warner.

Engineering is Civilization

Harry T. Woolson, SAE president for 1937, in his inaugural address envisioned engineering as a contribution to culture, to relief of human toil and to raising of the standards of living. Decrying the tendency to limit the term "engineer" to those who have completed an engineering course at a university, he pointed to the many famous engineers who wrought great works long before engineering systems as we now know them were in vogue. The march of modern civilization, he said, we owe in great measure to the engineer. "Engineering spells civilization and must go on."

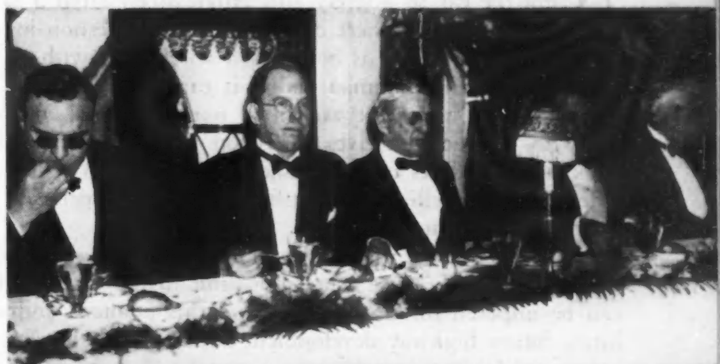
Reviewing the genesis and progress of the Society of Automotive Engineers, Mr. Wool-

On the Dais at the Dinner

(Left to right)

K. T. Keller
Dr. Hugo Eckener
W. J. Davidson

Blanche Noyes
Louise Thaden
Herbert L. Sharlock
Vincent Bendix
V. P. Rumely



Ralph R. Teetor
Harry T. Woolson
Col. H. W. Alden
John A. C. Warner
P. W. Litchfield

F. W. Von Meister
Hon. Fritz Hailer
Dr. Karl Arnstein
Dr. George W. Lewis
E. P. Warner

Nicholas Dreystadt
A. R. Smith
Alfred Reeves
S. G. McAllister

son laid down five major objectives for future SAE achievement. "We need to enlist within our ranks *all* automotive engineers qualified for membership," he said. "There are too many such outside our ranks today." Second, our standardization work, to acquire greater momentum and usefulness, should have our hearty encouragement. "Standards should be regarded as tools to aid industrial progress, not as a wall to restrict development." Third, research projects should be encouraged in every way. Fourth, valuable technical papers should be given even greater emphasis. Fifth, broader engineering relations should be stimulated by giving unbiased technical information bearing on technical matters for the benefits of various outside agencies including state regulatory bodies, motor vehicle commissioners, etc.

"A great star," Mr. Woolson concluded, "shines before us. As we follow its leading we shall be helping to build a better and truer civilization and to usher in a happier day." (Mr. Woolson's talk will be printed in full in the March SAE JOURNAL.)

Safety Responsibility Placed on Individuals

AS engineers we must exercise our prerogative of designing the car so actively and progressively from a safety standpoint that there can never be any question in anyone's mind but that it is being used wisely and with all the ingenuity of which human ability is capable.

As citizens, we must recognize our individual responsibility to conduct ourselves safely on the highways and to back up the efforts of enforcement authorities to reduce accidents along intelligent, scientific lines which experience has proved will produce results.

As taxpayers, we must insist on the wise expenditure of highway funds because there is a limit to the tax load that can be imposed for this purpose and this financial endpoint limits future highway development both from the traffic and safety standpoints.

These were the outstanding thoughts developed at the Safety Symposium, one of the most interesting and best attended sessions of the Annual Meeting. The program covered three fundamentals in the accident problem – the car, the driver and the road. The first of these was discussed by W. J. Davidson of General Motors, the second by Lieut. F. M. Kreml, director, Safety Division, International Association of Chiefs of Police, and the third by H. S. Fairbank, chairman of the Research Committee of the U. S. Bureau of Public Roads in collaboration with Thomas H. MacDonald, chief of that Bureau, who was unable to be present.

Chairman of the meeting was Miller McClintock, director of the Harvard Bureau of Street Traffic Research, who in presenting Mr. Fairbank credited to the Bureau of Public Roads under the leadership of Chief MacDonald a dominant part in developing America's present wonderful system of roads.

Engineer's Safety Responsibilities Analyzed

In fulfilling his responsibilities in connection with highway safety, Mr. Davidson said that the automotive engineer naturally regards as his first step detailed determination of the facts dealing with the engineer's share of the responsibility for accidents. On the basis of available data, he estimated that the car is held primarily responsible for a maximum of 10 per cent of the accidents. But when he attempted to analyze these data to classify mechanical failures, he reported that he ran into so many contradictions, that he was forced to the conclusion that the figures didn't mean a thing. Continuing he made a strong plea that enforcement authorities organize as promptly as possible to supply automotive engineers with accurate, comprehensive, factual accident data, compiled on a nation-wide uniform basis, so that engineers can learn something about what they, justly or unjustly, are being blamed for.

Viewing the car from a safety standpoint, Mr. Davidson said that he liked to think of its characteristics as being divided into two general classifications. Under the first of these he included items which affected maneuverability and control such as steering, brakes, acceleration, top speed, vision, seat comfort, position of steering wheel, position of pedals, headlights, etc. Believing that the extent to which these feaures contribute to the ease with which the driver can maneuver and control the vehicle with safety to himself and the other occupants, Mr. Davidson emphasized that "we want to make things in general so easy for the driver that he is mentally free to size up the road situation at all times . . . and to be able to concentrate on his job of driving without being hampered by adverse environment influences. We should therefore keep the driver's viewpoint constantly before us in dealing with these environment items."

The other safety classification made by Mr. Davidson was that of structure, which is of paramount importance after maneuvering possibilities have been exhausted and a collision takes place. On this score, Mr. Davidson reported that there was very little criticism. In the discussion, however, one speaker asked about the possibilities of further strengthening the car against side impacts to which Mr. Davidson replied that continued improvement along that line was, of course, desirable.

The features which are under the heaviest fire, Mr. Davidson continued, are top speed and headlamps. He reported a tendency to tighten speed regulations particularly in the East and said that there was some discussion of putting governors on cars to limit top speed. Lacking facts on the effects of governors on safety, he said that the best opinion was that they might well increase the hazards. In support of this viewpoint, he pointed out that the relatively small engines used abroad hold top speeds down, yet the fatality rates per 10,000 vehicles running are very much larger than here – the rates being 13.5 in the United States, 30.6 in England, 44.8 in Scotland and 59.4 in Italy. Evidently, Mr. Davidson pointed out, "lack of power in a motor car is not the answer to the safety problem."

On the speed question, also, test results thrown on the screen showed that average speeds are not as high as generally supposed. These tests were made on the four-lane highway connecting Detroit and Toledo on which there is no speed limit and revealed that in the day-time the average speed was 45.21 m.p.h. while at night the average was about 7 m.p.h. lower.

On headlamps, he said that engineers were providing the safest lighting they knew how to give and are trying unceasingly to find something better.

Turning to the human factors, Mr. Davidson said that a very practical selection of drivers is in the offing which means a tightening down of license requirements and the passage of license laws where none exist. In states with standard license laws, he showed, there has been about a 20 per cent drop in fatalities in the last ten years on the gasoline con-

Donor and Winners of Bendix Trophy

Louise Thaden, *center*, and her co-pilot Blanche Noyes, *right*, winners of the 1936 Vincent Bendix Trophy Race, are pictured here with Mr. Bendix, president of the Bendix Aviation Corp., and past-president of the SAE. This is the first time that women have won this transcontinental free-for-all speed dash which is held annually at the time of the National Air Races. Mr. Bendix has increased the amount of the purse for the 1937 race from $15,000 to $25,000.

sumption basis, while during the same period in states with sub-standard drivers' license laws or none at all, there had been a sharp increase.

Lieut. Kreml dealt with safety from the standpoint of controlling the driver. He stated emphatically that enforcement, education and engineering applied to the problem of traffic control had reduced accidents markedly in many cities and that similar results could be obtained in any city. Whether these results are obtained, he stressed, depends on the willingness of the individual to recognize and to assume his moral and social responsibility to conduct himself properly on the highways, and whether as citizens we encourage and support the enforcement authorities in intelligent, scientific efforts to deal with this problem.

"Let Highway Men Know Design Plans"

After tracing the development of our highway system and the rapidly changing requirements it is called upon to meet, Mr. Fairbank said that the highway engineer perhaps had better just admit "that the struggle to keep roads that live for 10, 15, 25 years up to vehicles with a life span of 5 to 7 years, is bound to be a losing one – unless he can get his friend, the automotive engineer, to tell him in advance which way he is going to jump next."

Mr. Fairbank also presented a survey of the most interesting and constructive highway planning survey now being carried on in 40 states under the auspices of the U. S. Bureau of Public Roads. This survey will throw light on how much road improvement we want and how much we think we need, but primarily it is intended to determine how much more the public will be willing and able to pay for in the long grind of continuous upkeep.

In this survey, a minutely detailed study of existing highway facilities and the use that is made of them, is being carried on. In addition, on the financial side of the picture, a similarly careful research is being made into what the present highway and road tax burden is, who bears this burden and the purposes for which the money is expended. Finally by the analysis of cost experience, the Bureau is endeavoring to determine the probable future annual costs of any determined road program – in other words, determining what maximum highway mileage may be constructed and maintained within the limits of probably available future annual road revenues.

In the discussion, Dr. Dickinson expressed discouragement over the apparent lack of interest in the relation between the driver and the vehicle as a factor in the accident situation. He said that every accident is the result of certain acts on the part of individuals and indicated that he felt it was imperative that we should know what these acts are before we can determine what steps should be taken to remedy the situation.

E. P. Warner said that it was commonly assumed that the reckless driver knows that he is driving recklessly, but some psychologists held the opinion that the causes of recklessness go far back into the personality of the individual, and that the only way to reach these causes is to change the personality of the individual, if that could be done. Commenting on Mr. Warner's remarks, Lieut. Kreml said that available statistics indicated that the accident-prone driver was not a serious factor in the problem. He said that a Rhode Island investigation showed that 75 per cent of those involved in accidents had no record of previous accidents or law violations.

Herbert Chase complimented the industry for improvements in safety glass, and for the adoption on some cars of recessed control buttons and door handles with their ends curved inward. Although some improvement had been made in visibility, he stressed the necessity for further progress along this line generally and in particular the reduction of the blind spot created by the windshield pillars.

In written discussion, Mr. Stevens asked about the desirability of flexible-spoke steering wheels. He also contended that rear-view mirrors should be larger, that side mirrors should be provided. He also spoke in favor of larger rear-view mirrors, the provision of a side mirror, and the development of suitable signaling equipment for use under winter and night traffic conditions.

Ring Sticking Attacked from Four Sides

A RECORD attendance of over 500 faced A. L. Beall, Wright Aeronautical Corp., session chairman, as he opened the Ring-Sticking Symposium on Wednesday afternoon. In four papers ring-sticking and allied problems were attacked from many different angles.

"So little real fundamental engineering data are available on cylinder wear that it is just about in a class with religion and politics as a controversial issue," contended Max M. Roensch, Chrysler Corp., in the introduction of his paper: "Observations on Cylinder Bore Wear." He explained that so many variables are involved that it is difficult to hold the conditions constant enough so that the effect of any one variable may be investigated. For this reason his paper shows only the trend of attempts to eliminate cylinder-bore wear.

"Since practically all the bore wear occurs in the piston-ring travel, it would seem that the trouble could be eliminated by concentrating our efforts on the piston-rings themselves or eliminating them entirely, but to date no solution for the latter suggestion has been developed, much to the relief of the piston-ring manufacturers," Mr. Roensch stated.

Classifying the causes of cylinder-bore wear into three main headings – abrasion, erosion, and corrosion – he explained that the conditions of operation, the design of the engine, the design of the air cleaner, piston and ring equipment, or lubricating oil used may change the order completely.

A field for valuable research, he stated, is to determine how good should oil economy be to give long life under average driving conditions. In closing he recommended that a committee be formed, under SAE auspices, to collect data on cylinder-bore wear under all operating conditions.

After over 160,000 miles of vehicle service, an average wear of only 0.0015 in. per cylinder at the end of ring travel, was reported by C. B. Lindsey, Los Angeles Railway Co., in written discussion relating the experience of his company. This record, he pointed out, was made on a coach using hardened replaceable sleeves.

The greatest cause of the cylinder-bore wear encountered in the operation of his company's 337 vehicles is overheating, particularly during the winter when the coaches are likely to run low on water, he reported. We try to stop this trouble, he concluded, by watching for increases in the fuel and oil consumption and disciplining drivers for negligence.

"The iron and bronze combination piston-ring and a ring containing a strip of phosphor-bronze offer so much improvement in ring and cylinder performance, particularly as regards scuffing, that their further use and investigation seem warranted," contended Paul S. Lane, Koppers Co., in written discussion. Since rings are fundamentally bearings, he explained, it would seem logical to incorporate a bearing metal structure in the ring, in so far as other necessary physical properties will allow.

High Temperatures Blamed

"Piston-ring sticking in high-speed Diesel engines is chiefly due to high operating temperatures causing deposits of lubricating oil residue, and is not the result of combustion products," believes A. W. Pope, Jr., Waukesha Motor Co., as contended in his paper, "A Mechanical Solution of the Diesel Piston Ring-Sticking Problem." This conclusion was formed, he explained, only after a series of tests on the C.F.R. single-cylinder engine equipped with a special ring-sticking test cylinder in which no ring sticking occurred until elevated temperatures were reached by raising the jacket temperature.

Two solutions are possible, Mr. Pope continued, one is a lubricating oil that will operate at high temperatures without the formation of sticky products and the other is by mechanical design.

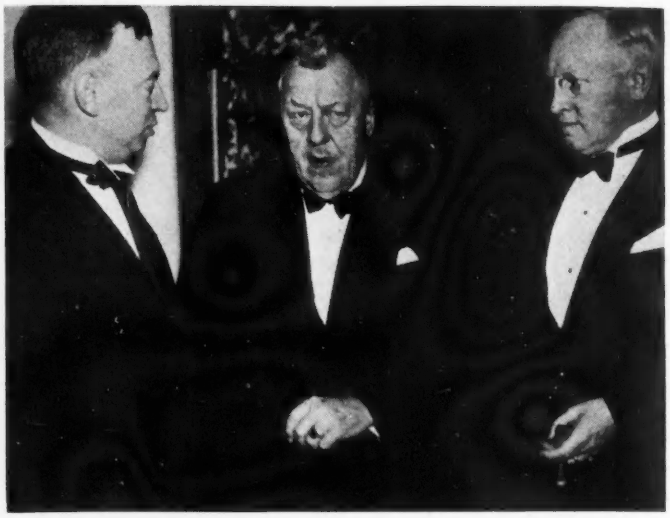
At this point Mr. Pope announced the principal contribution of his paper: "a simple one-piece piston-ring design that appears to eliminate completely piston ring-sticking tendencies regardless of what the temperature may be." The only part of his laboratory in its development, Mr. Pope qualified, was the conduct of an intensive test program to prove its design. The secret of this ring's design, he explained, consists simply in the tapered sides of the ring and groove, for which a 20 deg. included angle has given the best results.

Three features of this design account for its non-sticking features, Mr. Pope went on; they are that the tapered sections provide little opportunity for the sides of the lands to grip the ring, that it has an inherent self-cleaning action, and the tendency to force the ring outward when the inertia of the ring and compression pressure bear on the tapered side of the groove. These rings have been proved by 20,000 hr. successful service, Mr. Pope announced. "However," he warned, "oil producers need not sit back feeling that the ring-sticking difficulty has been solved by mechanical means as this design has created even more important lubricating-oil requirements."

"Alloyed steels made possible the modern automobile. Alloyed lubricating oils point the way to improved engine performance and greatly reduced maintenance," announced C. G. A. Rosen, Caterpillar Tractor Co., in his paper: "Engine Temperature as Affecting Lubrication and Ring Sticking."

Before blaming the oil man for most of the ills that befall our equipment, Mr. Rosen stated, we attacked the ring-sticking problem as one requiring careful investigation of our own product. In this investigation we covered the following influential factors, he continued: combustion process, design characteristics, metallurgical factors, machining opera-

Before the Annual Meeting Dinner



Dr. Hugo Eckener, *center*, is welcomed to the Annual Meeting by V. P. Rumely, *left*, chairman of the Detroit Section. It was Dr. George W. Lewis, *right*, who extended the Society's invitation to Dr. Eckener.

tions, and break-in and testing procedures. This two-year program of cooperation involved 11 oil refiners and 190,000 engine-hours of operation in the laboratory and many in the field, Mr. Rosen stated.

In conclusion, Mr. Rosen summarized: "Alloyed and compounded lubricants have produced outstanding results, both in the laboratory and in the field, in increased life of rings and cylinders, and in longer uninterrupted service." To back up this conclusion, he displayed slides showing the much cleaner condition of piston assemblies operated with compounded oils as compared with those run with straight lubricating oils.

Confusion About Ring Sticking

"Ring sticking can be cured by raising operating temperature, lowering operating temperature, increasing ring clearance, decreasing ring clearance, increasing oil consumption, and decreasing oil consumption," such was the confusion of Dr. Oscar C. Bridgeman after attempting to digest voluminous and conflicting data on the subject, in preparation for his paper: "The Problem of Ring Sticking in Aviation Engines." As a result Dr. Bridgeman concluded that the analysis would have to be made "without data or information."

"The cause of ring sticking," Dr. Bridgeman finds, "is the retention of any given portion of oil or fuel residue in the ring grooves long enough to permit thickening to the point where ring motion is restricted." As to its cure, Dr. Bridgeman concludes: "Ring sticking in aviation engines can only be controlled by continuous improvement in oil characteristics, by endeavoring to remove a greater amount of heat from the pistons, and by continued improvements in piston-rings."

Oil Industry Data on Ring Sticking

First to speak for the oil industry was J. P. Stewart, Socony-Vacuum Oil Co., with an appeal for better piston-ring fits. Arriving too late to be included in Dr. Bridgeman's paper his report was presented as a supplement. He described tests on two single-cylinder aircraft engines with piston-rings of various fits. When specifications for circularity and flatness were tightened up, less blowby and ring sticking were observed. Out of 121 commercial rings purchased, he concluded, only 21 met these specifications. Also needed are more statistical data from a greater number of engines and more reliable information on cylinder-wall temperatures, he added.

"In the last few years the oil refiners have developed processes to produce stable bases," contributed Ulric B. Bray, Union Oil Co. of Calif., "when they have gone the limit in this direction, they must add compounds to suit each job."

Replying to Mr. Stewart, H. M. Bramberry, Perfect Circle Co., suggested that cylinders out-of-round at temperature might be the cause of the difficulties blamed on the piston-rings.

"Three per cent of all piston-rings are stuck in engines sent in for overhaul at the Air Corps Depots of the Materiel Division," reported Robert V. Kerley, Air Corps Depot, Wright Field, in written discussion. This amount represents an average of almost 1500 overhauls, he continued, and indicates that the problem is serious enough to deserve consideration. Mr. Kerley then related the measures being taken to reduce this figure.

Ernest J. Abbott, Physicists Research Co., asked whether there had been any effort in any of the work reported to control surface finish. "There is a device," he suggested, "that will control it within millionths of an inch." In answer, Mr. Roensch stated that he had not attempted such control, although he believed it important and the device helpful. "We have studied the subject of finish to a considerable extent; it has a decided influence. The shorter the time for break-in, the better," was Mr. Rosen's reaction.

Surprise was expressed by W. G. G. Godron, Socony-Vacuum Oil Co., that an important factor had been neglected – the effect of the gas pressure behind the ring that forces the ring or film against the wall and explains why the maximum wear is always at the top of the cylinder.

More Power per cu. in. Seen in Future Engines

FEW of those attending the Engine Session on Thursday morning left with the smug feeling that all that is to be has been done after hearing P. M. Heldt, engineering editor, *Automotive Industries,* present his paper, "Powerplant

Possibilities of the Immediate and More Distant Future," which he prepared for and with the collaboration of the Passenger Car Activity Committee.

Within the next few years Mr. Heldt believes that there will be no pronounced move away from the present conventional chassis layout in American passenger-car practice, and that any change in engine design during this period will be such as to improve the present standard types. Immediate efforts, he said, will be toward increasing output per unit of displacement and per unit of weight, increasing fuel economy and increasing service life.

To increase specific output, he explained, we must increase either the brake mean effective pressure, the speed of revolution, or both. The b.m.e.p. can be increased by increasing compression ratio, but in doing this, he said, we are likely to run into detonation trouble. To combat this, Mr. Heldt foresees the development of composite cylinder heads with walls of low heat conductivity near the spark plugs and walls of high conductivity remote from spark plugs, which may pave the way toward higher compression ratios and higher specific outputs, without the risk of detonation. Mr. Heldt also looks for an increase in the antiknock value of commercial fuels.

The chief difficulty in increasing operating speed is roughness in operation and trouble from torsional vibration, Mr. Heldt said. This he believes can be combatted by stiffening all parts subjected to periodic forces or moments. It can also be attacked, he added, by reducing the amplitudes of the vibrating forces.

To solve the fuel economy problem Mr. Heldt sees possibilities in the use of the leanest possible mixtures, and the solution of the problem of uniform distribution. He therefore believes that it is more than likely that widths of spark plug gaps will be increased, as with longer gaps materially leaner mixtures can be ignited satisfactorily. This, he pointed out, will require higher spark voltages which conventional spark coils are unable to supply.

Mr. Heldt also foresees among other developments variable spark timing, reduction in stroke/bore ratios, forced fuel injection and improved valve materials.

In the second part of his paper Mr. Heldt looked into the more remote future when we shall see common adoption of either front-mounted engines with front drive or rear-mounted engines with rear drive. In either case, he explained, it is necessary to have plenty of weight on the driving wheels, to assure adequate traction even under unfavorable conditions, and also plenty of weight on the front wheels to assure dependable steering. It is necessary, in either case, he said, to have compact engines. Mr. Heldt devoted the major part of the second section of his paper to a discussion of engines applicable to either type of drive, giving particular attention to the requirements of mechanical balance and uniform spacing of explosions. The types of engines discussed include V engines with the angle between cylinder banks chosen to give uniform spacing of explosions; narrow V engines in which the angle is made as small as possible without interference between pistons in opposing cylinders; W engines having three banks of cylinders with pistons connected to a common crankshaft; fan-shaped engines in which there are three or more radially arranged cylinders with pistons connected to a common crankshaft; radial engines; "barrel-type" or round engines, and "flat" or "pancake" engines.

Between the two parts of Mr. Heldt's paper, Chairman E. H. Smith conducted a short business meeting of the activity at which members of the Nominating Committee were elected.

Discussion was opened by Boris P. Sergayeff, consulting engineer, who discussed the possibility of future adoption of the two-cycle Diesel engines. He spoke of the process of injecting oil in the form of superheated steam, compressed in the ratio of 21 to 1, into the combustion-chamber where pure air is precompressed. He mentioned an engine using this principle built by Jalbert in France in which the French Air Ministry took interest.

Mr. Heldt replied that he had not discussed the two-cycle engine because he thought the four-cycle is nearer to us. If fuel injection is developed it is possible that two-cycle Diesel engines may be adopted in the remote future, he added.

A. G. Herreshoff, Chrysler Corp., said that the place where the engine is located is of greater interest every day. The arrangement at present, he said, is both logical and rational. As engines become more compact and lighter it is hard to predict what may happen. They may be placed anywhere, but, judging from the past, he believes that further development will be along the rational lines we are accustomed to.

Austin Wolf sees necessity in studying thermal conditions around the combustion-chamber, particularly in the development of composite cylinder heads. With improved transmissions of more flexible ratios, he believes it will be necessary for the engine to work all of the time, rather than loaf most of the time as it does now. The high speed valve problem will have to be looked at from an entirely different point of view, he believes. Mr. Wolf sees the "barrel" type engine as a possible engine of the future. With it, he said, the crankcase structure can be eliminated except for endplates.

John Ames suggested direct blowers as the solution of cooling engines located in the rear, particularly radials.

Trailer Coach and Car Men Argue Design

PREDICTING a tourist-trailer output of 75,000 for 1937 instead of the baseless estimate of a quarter or half a million bruited about so frequently of late, Philip H. Smith, prominent New York journalist, said that the trailer industry will be sounder for slowing its acceleration. "A further mushroom growth," he concluded in his paper "Where is the Trailer Going?" at the Trailer Session on Tuesday morning, "would be likely to deplete the ranks of producers and multiply problems beyond hope of ready solution." (Mr. Smith's paper is printed in full beginning on page 45 of the Transactions Section of this issue.)

Leading trailer manufacturers and automobile engineers engaged in brisk discussion at this session. The question: "Are people supposed to ride in trailer coaches while the coaches are in motion?" – characterized by B. R. Scheff, Palace Travel Coach Co., as one of the oldest ever asked of trailer builders – brought a variety of answers indicating that it probably never will be answered short of legislative edict. Trailer coaches, according to Mr. Scheff, who is vice-president of the Trailer Coach Manufacturers Association, are designed as homes which can be moved about; not for use while in motion. W. Russel Wilday, secretary of the T.C.M.A., on the other hand, said that, as a trailer user, he frequently permits his children to ride in the trailer even while driving through quite hilly country. Herbert Hosking, editor, *Automotive Industries,* pointed out that many items of trailer

(Continued on page 43)

Photo by Lee F. Redman

Harry T. Woolson
President for 1937

Officers for 1937

HARRY T. WOOLSON had made a real name for himself as a marine engineer before he began the brilliant career in automobile design which has made him executive engineer of the Chrysler Corp., and President of the SAE for 1937.

For 16 years he designed in all branches of marine engineering, but specialized particularly in gasoline motors. He first came into the automobile field in 1915 as truck engineer at Packard, following five years as chief engineer of the Gas Engine & Power Co. and Charles L. Seabury & Co., Consolidated, now the Consolidated Shipbuilding Co.

But before doing any of these things he saw service in the U. S. Navy during the Spanish-American War. He enlisted shortly after the war broke out and served six months as second-class machinist. Prior to his enlistment he had been working as draftsman at the National Meter Co.—his first job following graduation from Stevens Institute of Technology with an M.E. degree in 1897.

Working in research and design at Studebaker, which he joined in 1916, Harry Woolson first came into intimate contact with Fred M. Zeder, Carl Breer and Owen R. Skelton—and when that dynamic trio tied up with Walter P. Chrysler in the Willys Corp. venture in the huge plant at Elizabeth, N. J., in 1920, Woolson went with them and became chassis engineer at Willys. Subsequently he was prominently identified with the Zeder-Skelton-Breer Engineering Co. in Newark, and in 1924 joined Maxwell in Detroit.

Harry Woolson was chief engineer of that company when its final product, "The Good Maxwell" was designed—and he was chief engineer of the new Chrysler Corp. a year later, playing an important part in the design of the original Chrysler car—the product upon which Walter P. Chrysler began his meteoric rise to manufacturing stardom.

Remaining as chief engineer until his promotion to the position of executive engineer in 1935, Harry Woolson has contributed broadly as an executive as well as a designer to Chrysler Corp.'s engineering success. Several patents pertaining to mechanical devices utilized in the automotive industry are in his name.

He joined the SAE in 1922, while still in Newark. Four years later, he began active participation in Society work, his first assignment being as a member of the transmission division of the Standards Committee. Since then he has served on many important technical and administrative committees, including the Meetings, Sections, Research and Standards Committees.

He first became an officer of the Society in 1928 when he served as vice-president representing Marine Engineering. He was a Councilor-at-large in 1932, 1933, 1935 and 1936. In 1935 he was a member of the Passenger-Car Activity.

He has been equally active in Section affairs, leading the Detroit Section as chairman in 1934, after having been vice-chairman in charge of student activities the previous year.

Past-Presidents Ralph R. Teetor (1936) and William B. Stout (1935) will serve on the 1937 Council.

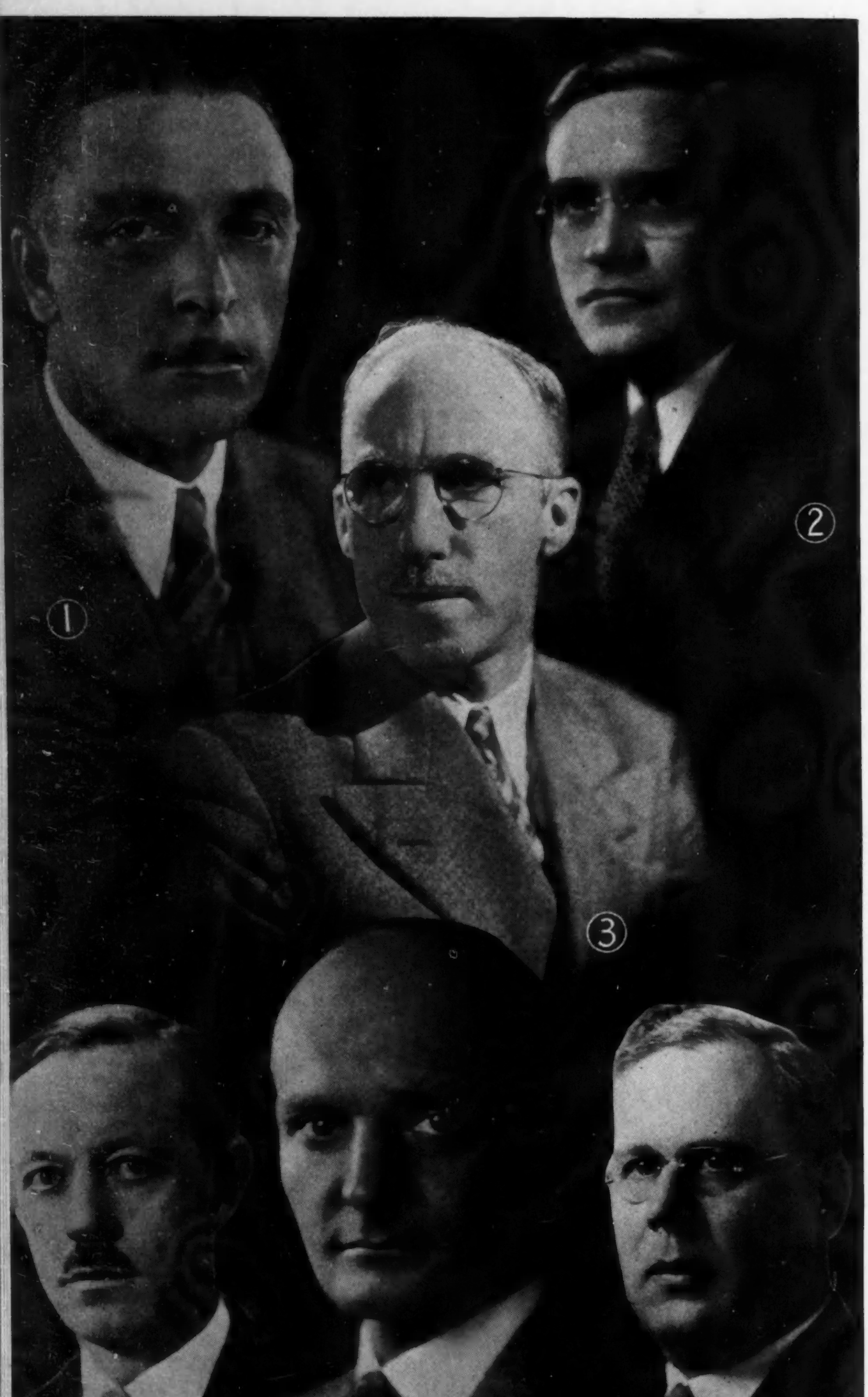
Treasurer David Beecroft in 1937 serves his fifth term in that capacity.

Photo by Blank & Stoller

Photo by Lee F. Redman

Treasurer Beecroft
Past-President Teetor
Past-President Stout

Vice-Presidents Representing



1. A. L. Beall, research engineer, Wright Aeronautical Corp., is the new vice-president representing the Aircraft-Engine Engineering Activity. He has been affiliated with the automotive industry since 1911 when he was junior engineer with the H & N Carburetor Co. Since then he has been connected with the Prest-O-Lite Co., Inc., Automotive Electric Service Corp., Westinghouse Union Battery Co. and the Vacuum Oil Co. He was with the latter company for eight years, in various engineering capacities before joining the Wright Aeronautical Corp. in 1933. Mr. Beall has been a member of the Society since 1924 and has been particularly active on SAE administrative and research committees. He has served as chairman of the Meetings Committee, vice-chairman of the Membership Committee, vice-chairman of the Fuels and Lubricants Activity Committee, chairman of the Ignition Research Committee and secretary of the Metropolitan Section. In 1936 he served on 10 committees. He is one of three SAE representatives on the American Standards Association Sectional Committee on Petroleum Products and Lubricants.

2. John M. Orr, vice-president representing Transportation and Maintenance Engineering Activity for 1937, has been in the Pittsburgh district during his entire business life. Graduated from the Division of Industries, Carnegie Institute of Technology in 1915, he went to work for the Duquesne Light Co., left in 1920 to spend seven years as assistant general manager of the United Electric Light Co. at Wilmerding, and then returned to the Duquesne Light Co., as assistant to the vice-president and general manager. A year later he was made general manager of Equitable Auto Co., the centralized motor-vehicle division of the Philadelphia Co. and its subsidiaries, of which Duquesne Light is one.

He joined the SAE in 1928 and in 1931 was chairman of the Pittsburgh Section. He has been a member of the Transportation and Maintenance Committee since that year, and in 1934 was vice-chairman. Since 1934 he has also been a member of the Transportation Division of the Standards Committee.

3. C. Herbert Baxley, who becomes vice-president representing the Fuels and Lubricants Activity, is on the headquarters engineering staff of the Socony-Vacuum Oil Co. specializing in domestic and foreign aviation problems. He is a graduate of the Engineering School of The Johns Hopkins University and continued in mechanical engineering at the Polytechnic Institute of Brooklyn. His first affiliation with the automotive industry was as assistant superintendent of production, American Hammered Piston Ring Co., in 1920. Since then he has been instructor in mechanical engineering and head of the mechanical laboratory, Pratt Institute, and has been connected with the petroleum industry for the past eight years. From 1929 until 1933 he held various engineering positions with the Vacuum Oil Co. He then joined the Sinclair Refining Co. as staff engineer serving in that capacity until taking his present position with the Socony-Vacuum Oil Co. early last fall. Mr. Baxley has held prominent offices in the Metropolitan Section and has been active on the Society's Fuels Research Committee. Last year he was vice-chairman of the Fuels and Lubricants Activity Committee. He joined the Society in 1928.

4. Leo L. Williams is SAE vice-president representing the Passenger-Car-Body Activity for 1937. Since 1910 he has been affiliated with the automotive industry. At that time, and until 1917, Mr. Williams was body designer with the Peerless Motor Car Co. From 1919 until 1921 he was successively with the Lang Body Co., the Automotive Service Co., and the E. J. Thompson Co. In 1923 he joined the Cleveland Automobile Co. as body engineer. At the time of the Chandler-Cleveland merger in 1927 he continued in the same capacity with the new company. In

SAE Activities for 1937

1930 when the Hupp Motor Car Corp. bought the Cleveland body plant of the Chandler-Cleveland Motors Corp., Mr. Williams was retained as body engineer. In 1933 he was made chief engineer of the Cleveland division of Hupp. Subsequently he has been consultant in passenger-car and bus design and manufacture. A member of the Society since 1918, Mr. Williams has twice been chairman of the Cleveland Section and has served on the Passenger-Car-Body Activity Committee.

5. W. S. James, chief engineer, Studebaker Corp., is 1937 vice-president representing the Passenger-Car Engineering Activity. While working for his B.S.M.E. at George Washington University, which he received in 1917, Mr. James was also employed as assistant physicist at the United States Bureau of Standards. In 1919 he was made associate physicist and in 1922 physicist. Leaving the Bureau in 1925 he went with the Associated Oil Co. as assistant technologist. In 1927 he joined Studebaker as research engineer and was appointed to his present position in November of last year. He became a member of the SAE in 1918. Since 1922 he has served on the Research Committee and has been active in the work of many of its divisions. He has likewise served on the Lubricants Division of the Standards Committee, the Publication Committee, the Sections Committee and the Meetings Committee. He is one of five SAE representatives on the American Standards Association Sectional Committee for Safety Code for Brakes and Brake Testing.

6. Robert R. Keith, new vice-president representing the Production Engineering Activity, is manager of the J. I. Case Threshing Machine Co. tractor works. Prior to joining the Case company in 1929 he was in charge of motor truck, coach and all automotive transportation engineering of the International Harvester Co., with which he became affiliated in 1921. In earlier years Mr. Keith was tractor works manager and in general charge of plant, Moline Plow Co.; works manager and in general charge of plant, Holt Co., Peoria Works; assistant superintendent and charge of plant, Three Rivers Works, Fairbanks Morse Co. He has been active in the Society since becoming a member in 1922. Last year he was a member of the Production Activity Committee and prior to that he has served on the National Meetings Committee, the Production Division, the Truck Division and the Engine Division of the Standards Committee. Mr. Keith received his B.S. in M.E. degree from Iowa State College in 1902.

7. Elmer McCormick, chief engineer, John Deere Tractor Co., will represent the Tractor and Industrial Power Equipment Engineering Activity as vice-president during 1937. Mr. McCormick has been in the employ of Deere & Co. over 25 years. His early training began as a draftsman in the various implement plants during the time he was earning his B.S. degree at the University of Illinois. Receiving his degree in 1914 he continued doing general engineering work but was mainly interested in the design of tractors, which the company was developing. He was advanced from engineer and motor designer to superintendent and chief engineer of this development work in 1918. In the fall of 1918, to get into the manufacture of tractors, Deere & Co. purchased The Waterloo Gasoline Engine Co. to which Mr. McCormick was transferred. In 1920 he was made sales manager, a position he held until 1928. In 1925 the name of the company was changed to the John Deere Tractor Co. He again turned to the technical side of the business and was made assistant chief engineer in 1929, becoming chief engineer in 1931. Mr. McCormick became a member of the SAE in 1917. Since 1934 he has served on the Tractor and Industrial Power Equipment Activity Committee and the Parts and Fittings Division of the Standards Committee, serving as vice-chairman of both last year. He was also a member of the Lubricants Division of the Standards Committee last year.

8. Stephen Johnson, Jr., who will serve during 1937 as vice-president representing the Truck, Bus and Railcar Engineering Activity is chief engineer, Bendix-Westinghouse Automotive Air Brake Co., chairman of the Pittsburgh Section, and has been active on the Truck, Bus and Railcar Activity Committee, the Gasoline Engine Division of the Standards Committee and the Brake Committee. Between high school and college Mr. Johnson served a four-year apprenticeship as a machinist and draftsman with the Newport News Shipbuilding & Dry Dock Co. In 1923 he was graduated from the University of Michigan Engineering College with his B.S. degree. He immediately joined the Westinghouse Air Brake Co. and was assigned to their Chicago office, serving as mechanical expert and later as assistant district engineer. He was transferred to Pittsburgh in 1929 and appointed general engineer in charge of engineering of the automotive division. In 1930, on formation of the Bendix-Westinghouse Automotive Air Brake Co., he was appointed chief engineer, which position he now holds. He joined the SAE in 1930.

9. Arthur W. Pope, Jr., takes office as vice-president representing the Diesel-Engine Engineering Activity. He is research engineer with the Waukesha Motor Co. and chairman of the Milwaukee Section. Following an academic course at Yale he studied mechanical engineering at the Massachusetts Institute of Technology, receiving his B.S. degree in 1918. That January he was commissioned ensign in the United States Navy, Bureau of Steam Engineering. The following November he was made assistant to the officer in charge of the aeronautical-engine test laboratory at the Navy Yard, Washington, D. C. After leaving the Navy he joined the works engineer's department at Nash and later, in 1920, established his own automotive sales and maintenance business in Kenosha, Wis. In April, 1923, he joined the research department of Waukesha Motor Co., becoming research engineer in 1926. Mr. Pope joined the Society in 1925 and has been active in the Milwaukee Section and on committees of the National Society. Last year he was a member of the Diesel-Engine Activity Committee, the Crankcase Oil Oiliness Research Committee, the Steering Committee of the Cooperative Fuel Research Committee, and was SAE representative on the American Standards Association Sectional Committee on Petroleum Products and Lubricants.

10. Fred E. Weick, who takes office as vice-president representing the Aircraft Engineering Activity, has recently joined the Engineering and Research Corp., Washington, D. C., as chief engineer. Before this change of position he was aeronautical engineer with the National Advisory Committee for Aeronautics. He had been affiliated with the N.A.C.A. since 1925 except for a period in 1929 and 1930 when he was chief engineer of the Hamilton Aero Manufacturing Co. With the N.A.C.A. he conducted the first full-scale wind-tunnel research on aircraft propellers and did research on drag and cooling of radial air-cooled engines culminating in the design and development of the N.A.C.A. cowling. More recently he organized a group of N.A.C.A. engineers to see what could be done to develop an airplane for private flying. Mr. Weick designed the W-1 and W-1A experimental airplanes used by the Department of Commerce as a part of its development program of airplanes for private use. Associated with the aviation industry since 1922 when he received his B.S. degree from the University of Illinois, he was with the U. S. Airmail Service, the Yackey Aircraft Co. and the Bureau of Aeronautics, Navy Department, before joining the N.A.C.A. He became an SAE member in 1929 and has been a member of the Aircraft Activity Committee and the Wright Brothers Medal Board of Award since 1934, serving as chairman of the latter in 1936.

SAE Councilors for 1937

1. Walter C. Keys, mechanical product engineer, U. S. Rubber Products, Inc., will serve as Councilor during 1937 and 1938. He was previously a Council member in 1932. He had his early automotive experience (1905-1912) with Buick Motor Co., U. S. Motor Co., Cadillac Motor Car Co., Chalmers Motor Co., and the Church-Field Motor Co. In 1913 he rejoined Cadillac as assistant chassis engineer. In 1917 he joined the Perfection Spring Co. as mechanical engineer. During 1918 to 1927 Mr. Keys had executive engineering posts with the Standard Parts Co., the Eaton Axle Co., and the Gabriel Sales and Service Co., successively. He joined the United States Rubber Co. in 1927 as chief engineer, mechanical automotive department. Mr. Keys, a member of the SAE since 1915, has been active on numerous divisions of the Standards Committee since 1917. He has also served on the Passenger-Car Activity Committee, the Sections Committee, the Membership Committee and the Riding Comfort Research Committee. In 1934 and 1935 he was chairman of the Life Membership Committee. He received his B.S.E.E. from the University of Michigan.

2. John L. Stewart, Councilor for 1937-1938, has been general manager of the Canadian Automobile Chamber of Commerce since 1931. Before that he was, for 15 years, manager of the automotive division of the Maclean Publishing Co. Mr. Stewart became a member of the Society in 1932 and the following year served as vice-chairman of the Canadian Section. He was elected chairman of the Section in 1934. In that year he was also a member of the Membership Committee and for the past three years he has been active on the Lubricants Division of the Standards Committee. Mr. Stewart was born in Detroit, but moved to Canada at an early age. He was educated at the Queen Victoria School and Hamilton College.

3. A. T. Colwell, who will serve on the SAE Council during 1937 and 1938, is director of engineering, Thompson Products, Inc. A graduate from the United States Military Academy at West Point, class of 1918, his education continued at the Engineer School, U. S. Army, at Fort Humphreys, Va., from which he received his C.E. degree in 1920. Promoted to first lieutenant, he continued in the Army for two years. He then resigned to join the Steel Products Co., which later became the Thompson Products Co. After a period during which he was in charge of sales and engineering in that company's Michigan territory, Mr. Colwell was appointed chief engineer in 1930. In that year he became a member of the SAE. He was advanced to his present position in 1934. He served as vice-chairman of the Cleveland Section in 1935 and as chairman the following year. Mr. Colwell has contributed to the work of the Society by serving on the Production Activity Committee in 1934 and 1935, the Tractor and Industrial Power Equipment Activity in 1935 and 1936, the Sections Committee and the Iron and Steel Division and the Parts and Fittings Division of the Standards Committee in 1936.

4. Louis Schwitzer, president of the Schwitzer-Cummins Co., is serving his second year as a member of the Council. Born in Beelitz, Austria, he received his education in mechanical and electrical engineering at the Universities of Karlsruhe and Darmstadt, Germany. Before coming to the United States Mr. Schwitzer was connected with the automotive industry in France. In 1912, the year in which he joined the Society, he was chief engineer of the Empire Automobile Co. Since then he has been chief engineer of The Oakes Co., and president and chief engineer of the Automotive Parts Co. In 1931 he became president of the Schwitzer-Cummins Co., which position he now holds. Mr. Schwitzer was chairman of the Indiana Section in 1931 and has been active on the Engine Division of the Standards Committee, the Meetings Committee and the Sections Committee.

5. Alex Taub continues as a member of the Council during 1937. Affiliated with the General Motors Corp. since 1919, he is now in England carrying on powerplant research and development work for General Motors-controlled Vauxhall Motors, Ltd. Prior to his current position, which he took early last November, Mr. Taub was for seven years development engineer with Chevrolet. Born in London, England, he came to the United States in 1907 and started as a lathe operator in an auto parts concern. His work since that time has been in the automotive field. Joining the SAE in 1912 he has since taken an active part in the Society's work. He has served as chairman of the Detroit Section, chairman of the Membership Committee, chairman of the Meetings Committee and chairman of the Engineering Display Committee. He has been a member of the Passenger-Car Activity Committee for eight years and a member of the Research Committee for seven. He has also been active on the Passenger-Car and other divisions of the Standards Committee.

6. Joseph A. Anglada, who continues as Councilor during 1937, is engineering consultant in New York. His affiliation with the automotive industry dates from 1900 when, shortly after completing his course in mechanical engineering at Columbia University, he did design and experimental work for the International Power Co., manufacturers of electric vehicles. Subsequently he held important posts in the design and development of automotive vehicles and parts. He practiced as consulting engineer from 1919 until 1928 when he organized and became president of the Anglada Motor Corp. He resumed his practice of engineering consultant in 1936. Mr. Anglada was previously a member of the Council in 1913 and 1914. During the same two years he was chairman of the Metropolitan Section. Mr. Anglada has also been active on the Sections Committee, the House Committee, the Placement Committee and many of the Society's technical committees. He has likewise represented the SAE on several Sectional Committees of the American Standards Association.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Dec. 10, 1936, and Jan. 10, 1937.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Barton, Harold (J) layout draftsman, Consolidated Aircraft Corp., Lindbergh Field, San Diego, Calif.

Beverlin, Robert S. (J) chief engineer, Hall Mfg. Co., Toledo, O.; (mail) 4117 Willys Parkway.

Brown, Julius L. (J) factory clerk, Ward Motor Vehicle Co., Mt. Vernon, N. Y.; (mail) 4328 Matilda Ave., New York City.

Brunner, Elmer F. (M) charge, tractor tire development, Goodyear Tire & Rubber Co., Akron, Ohio; (mail) 81 Hastings Rd., Cuyahoga Falls, Ohio.

Burke, Edwin Woodward (J) aviation cadet, U. S. Navy, VF Squadron 1-B, Fleet Air Detachment, Coronado, Calif.

Campbell, Lester Francis (M) chief inspector, Pratt & Whitney Aircraft Co., East Hartford, Conn.; (mail) 20 Franklin St., Manchester, Conn.

Chapin, Noel (M) automotive service engineer, Cities Service Oil Co., 4614 Prospect Ave., Cleveland, Ohio; (mail) 15000 Euclid Ave.

Christensen, Harold (M) cone worm gear engineer, Michigan Tool Co., 7171 E. McNichol, Detroit, Mich.; (mail) 77 Cortland Ave., Highland Park, Mich.

Connery, David Pugsley (A) publicity and advertising representative, N. W. Ayer & Son, Inc., 4200 Penobscot Bldg., Detroit, Mich.

Cook, William Charles (FM) Public Works Dept., Head Office, Wellington, N. Z.

Cox, Chester Ashton (A) partner, Robbins & Cox, 66 Beale St., Woolaston, Mass.; (mail) 229 Arlington St.

Doane, F. B. (M) vice-president, Magnaflux Corp., 333 N. Michigan Ave., Chicago, Ill.

Duell, Clifford C., Capt. (SM) U. S. Army, Field Artillery Board, Fort Bragg, N. C.

English, E. B. (A) manager, Washington office, Caterpillar Tractor Co., 1134 Munsey Bldg., Washington, D. C.

English, John Alden (J) Motor Magazine, 572 Madison Ave., New York City; (mail) 154 Penna Ave., Easton, Pa.

Fuller, Edwin M. (A) sales engineer, Lamson & Sessions Co., 1971 W. 85th St., Cleveland, Ohio; (mail) 213 University Dr., Kent, Ohio.

Hansen, Tage (J) service manager, Arlington Oldsmobile, 745 Massachusetts Ave., Arlington, Mass.; (mail) 46 Farmcrest Ave., Lexington, Mass.

Hare, Weldon P. (M) engineer, King-Seeley Corp., 315 S. First St., Ann Arbor, Mich.; (mail) 1308 Linwood Ave.

Harlan, Wilbur (A) fleet superintendent, Gordon Baking Co., 5324 Federal St., Chicago, Ill.

Harrison, Charles C. (J) secretary, Harrison Oil Co., 5110 N. 35th St., Milwaukee, Wis.

Head, Willard H., Sr. (A) garage superintendent, Public Service Co. of N. H., Manchester, N. H.; (mail) 1087 Elm St.

Henig, Ludwig (J) engineer, Luscombe Airplane Development Corp., West Trenton, N. J.; (mail) R.R. 1, Titusville, N. J.

Hesley, Karl F. (A) special representative, Collins & Aikman Corp., 200 Madison Ave., New York City; (mail) 2300 Fisher Bldg., Detroit, Mich.

Hunter, H. Clifford (M) research chemical engineer, Gulf Research & Development Co., Box 2038, Pittsburgh, Pa.; (mail) 829 Fifth St., Oakmont, Pa.

Johnson, James W. (A) president, James W. Johnson & Co., Inc., 95 Liberty St., New York City.

Jones, Henry Ware, Jr. (M) president, general manager, Amer. Tube Bending Co., Inc., 5 Lawrence St., New Haven, Conn.

King, Robert E. (J) electric arc welding engineer, weld tester, Manitowoc Shipbuilding Corp., Manitowoc, Wis.; (mail) 913 Huron St.

Klipper, Nathaniel A. (J) 5559 Magnolia Ave., Chicago, Ill.

Knoll, Felix W. A. (M) aeronautical engineer, Seversky Aircraft Corp., Farmingdale, L. I., N. Y.; (mail) 162 Conklin St.

Latham, Ray L. (J) engine design technician, Chrysler Motor Corp., Highland Park, Mich.; (mail) 15878 Griggs Ave.

Lopez, Rufino (J) mechanical engineer, aircraft instrument specialist, Pan Amer. Airways, Inc., Western Div., Off State Highway 4, Brownsville, Tex.; (mail) Eighth & Washington Sts., Box 809.

Lydecker, Frederick Reimer (A) prestone specialist, National Carbon Co., 30 E. 42nd St., New York City; (mail) 788 East Ave., Rochester, N. Y.

Marchant, L. R. (A) manager, Illinois Farm Supply Co., Room 1200, 608 S. Dearborn St., Chicago, Ill.

McGuire, Robert C. (J) 143 Main St., Hempstead, L. I., N. Y.

Meile, Ferd W. (A) sales engineer, Rollway Bearing Co., Syracuse, N. Y.; (mail) 6432 Cass Ave., Detroit, Mich.

Merrill, S. Clifford (M) district manager of sales, Timken Roller Bearing Co., Fisher Bldg., Detroit, Mich.

Oestrike, Wilfred C. (J) junior engineer, Packard Motor Car Co., Detroit, Mich.; (mail) 78 W. Ferry.

Ostruk, Paul (M) president, production manager, Jackomatic Corp., 250 W. 54th St., New York City.

Pelke, Arthur A. (M) dist. service representative, Chevrolet Motor Div., General Motors Sales Corp., 1775 Broadway, New York City; (mail) 8023 236th St., Bellerose, L. I., N. Y.

Perry, Harold Gladstone Bright (FM) chief engineer, Standard-Vacuum Oil Co., Inc., P. O. Box 154, 94 Canton Rd., Shanghai, China.

Persily, Clemens C. (A) fleet sales, Chevrolet Motor Div., General Motors Sales Corp., 1881 Broadway, New York City.

Pittman, Kenneth Fleetwood (J) engineer, purchasing agent, Standard Carriage Works, Inc., 721 S. San Pedro St., Los Angeles, Calif.

Sharpe, Willard H. (A) service manager, Coombs & McBeath, 660 Beacon St., Boston, Mass.; (mail) R.F.D., Rockland, Mass.

Stevens, Louis (A) superintendent of garage, U. S. Army, Fort Brady District, Motor Transportation Office, Fort Brady, Sault Ste. Marie, Mich.

Stoughton, George H. (J) instructor, General Motors Inst., Flint, Mich.

Sunnen, Gus (A) general manager, Sunnen Products Co., Ltd., Chatham, Ont., Canada.

Turcotte, Herman O. (A) superintendent of laboratories, U. S. Diesel Engrg. School, 89-91 Brighton Ave., Boston, Mass.

Turner, George Wm. (A) manager, commercial department, Castner Garage, Ltd., Schofield Barracks, T. H.

Turner, Van (A) editor, Chexall div., Chek-Chart Corp., 624 S. Michigan Ave., Chicago, Ill.

Ward, J. Carlton, Jr. (M) assistant general manager, United Aircraft Corp., Pratt & Whitney Aircraft Div., East Hartford, Conn.

Wiener, Leonard S. (J) analytical engineer, Aviation Mfg. Corp., Lycoming Div., Williamsport, Pa.; (mail) 1804 Memorial Ave.

Wood, Charles S. (J) sales engineer, Stephens-Adamson Mfg. Co., 50 Church St., New York City; (mail) 35 Courrier Pl., Rutherford, N. J.

Applications Received

The applications for membership received between Dec. 15, 1936, and Jan. 15, 1937, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Beckwith, Bryson B., metallurgist, Chrysler Corp., Detroit, Mich.

Brinen, Howard F., research department, Young Radiator Co., Racine, Wis.

Brown, Jack L., 1001 E. Fifth Street, Royal Oak, Mich.

Brownlee, Clarence S., president, Dickson Gasket Co., Chicago, Ill.

Christian, Frank M., 1403 Wright St., Los Angeles, Calif.

Cousins, Roy F., garage superintendent, Davidson Baking Co., Portland, Oregon.

Dalzell, C. W., chief electrical engineer, Heyer Products Co., Inc., Belleville, N. J.

Dannegger, Carl, director, Etablisements Max Thirion, Societe Anonyme, Bruxells, Belgium.

Fairfield, Wallace M., Fafnir Bearing Co., New Britain, Conn.

Fife, Mervyn George, service manager, Chrysler Corp. of Canada, Ltd., Windsor, Ont., Canada.

Fisher, Gerald M., chief chemist, General Petroleum Corp. of California, Los Angeles, Calif.

Friedlander, Sidney, service manager, Alicino & Levy, Inc., New York City.

Frost, Howard A., assistant to production and engineering departments, Hastings Mfg. Co., Hastings, Mich.

Gagg, Rudolph Farwell, assistant chief engineer, Wright Aeronautical Corp., Paterson, N. J.

Gohn, Emil P., automotive engineer, The Atlantic Refining Co., Philadelphia, Pa.

Griffin, Robert Hall, salesman, Wilkening Manufacturing Co., Los Angeles, Calif.

Hamilton, William F., Richfield Oil Co. of California, Los Angeles, Calif.

Hanson, George, mechanical engineer, Department of Water & Power, Los Angeles, Calif.

Hanson, J. M., division superintendent, Hudson Motor Car Co., Detroit, Mich.

(Continued on page 38)

About SAE Members:

Herbert L. Sharlock, Bendix Products vice-president, has been elected secretary of the Motor & Equipment Manufacturing Association for 1937.

L. C. Conradi, heretofore metallurgist for the International Business Machines Corp., has been promoted to the position of technical research director at that company's Endicott, N. Y., plant. This appointment places him in direct supervision of the IBM chemical, metallurgical, paper testing and electrical laboratories.

L. C. Conradi
Directs Research

O. T. Kreusser, who recently returned to General Motors after having been director of the Museum of Science and Industry in Chicago for five years, has been appointed general manager of the Allison Engineering Co. division of GMC at Indianapolis.

Thomas J. Litle, Jr., has been appointed chief engineer of the Easy Washing Machine Corp. He was previously chief engineer of the Evans Products Co., Detroit. Mr. Litle is a past-president of the SAE.

T. P. Wright, vice-president of engineering, Curtiss-Wright Corp., tells some of the problems met in sub-stratosphere flying in an article appearing in the Jan. 10 issue of the New York *Times.*

Raymond Loewy is designer of the show window awarded the annual grand prize in the Fourth Annual Show Window Contest conducted by the Electrical Association of New York, Inc. The window, one in a Cushman's Son bakery located in Richmond Hill, Queens, N. Y., was chosen from among more than 5000 entries. Mr. Loewy is known for his work as design consultant on passenger cars, trucks, buses, streamline locomotives, bus terminals, filling stations, refrigerators and other products.

Raymond Loewy
Designer

Wing Com. Lawrence James Wackett recently was made manager of the Commonwealth Aircraft Corp., Melbourne, Australia. Previously he was managing director and designer with Tugan Aircraft, Ltd., Sydney.

Ralph R. Graichen has been named chief engineer of Curtis Aerocar Co., Inc., Coral Gables, Fla.

Fred E. Weick, long affiliated with the National Advisory Committee for Aeronautics as aeronautical engineer, has joined the Engineering & Research Corp. as chief engineer. Mr. Weick is SAE vice-president representing Aircraft Engineering. His picture and biographical sketch appear on p. 23 of this issue.

W. E. England has been made chief engineer of the Willys Overland Motors, Inc. Formerly chief engineer of the Ohio Rubber Co., he joined Willys late last year. Prior to his affiliation with the Ohio Rubber Co. in 1934, Mr. England was engineer in charge of the experimental department of Auburn, and before that he was, for nine years, chief engineer of the F. B. Stearns Co., producers of Stearns-Knight automobiles.

W. E. England
Willys Chief Engineer

Charles F. Kettering was honored at a civic dinner given in his honor at Dayton, Ohio, Jan. 9. Mr. Kettering was a resident of Dayton for 32 years.

Harry J. Carmichael, vice-president and general manager of General Motors of Canada, Ltd. has been appointed to the directorate of the Bank of Toronto, Toronto, Canada.

A. L. Teodoro, head of the agricultural engineering department, University of Philippines, Agricultural College, is co-author, with E. K. Ongsansov, of a series of articles on "Alcohol and Alcohol-Blends as Fuels for Automobile Engines", appearing in the *Philippine Agriculturist.*

Courtesy of House Beautiful — *Gass Photo*

The Bronxville, N. Y., home of Dr. Graham Edgar, director of research, Ethyl Gasoline Corp., recently was awarded highest honors in a small house competition sponsored by *House Beautiful.*

F. E. Moskovics has recently been named chairman of the executive committee of the Dictograph Products Co. Mr. Moskovics is the SAE representative on the board of directors of the American Standards Association.

S. R. Hammond, until recently editor of *Trade Lanes,* Portland, Ore., has been promoted to the position of assistant manager, Shipping News, Inc., Seattle, Wash. This company owns *Trade Lanes* in addition to several other publications, including *Marine Guide* and *Routing Guide.* Mr. Hammond was SAE Journal field editor for the Oregon Section before this change took him to Seattle.

J. M. Watson, who has for 22 years been affiliated with the Hupp Motor Car Co. as metallurgical engineer, has joined the Detroit district sales office of the Jones and Laughlin Steel Corp.

J. M. Watson
Takes New Position

W. B. Lashar has been elected chairman of the board of the American Chain & Cable Co., Inc. He was previously president of this company which has recently taken the above name. It was formerly known as the American Chain Co., Inc.

John Madincea is president and chief engineer of Uzinele Domane De Automobile, Ltd., Detroit. He was formerly with Chrysler Corp. as commercial car designer.

Receives Perkin Medal

Thomas Midgley, Jr., vice-president of the Ethyl Gasoline Corp. and Kinetic Chemicals, Inc., was presented with the Perkin Medal of the Society of Chemical Industry on Jan. 8 at a joint meeting of the American Section of the Society of Chemical Industry and the American Chemical Society in New York. The medal was given to Mr. Midgley for his work in the development of antiknock motor fuels and safe refrigerants. The program included a talk by Robert E. Wilson, vice-chairman of the Pan-American Transport Co., on the accomplishments of the medalist. Mr. Midgley's medal address was titled "From the Periodic Table to Production". He was awarded the Nichols Medal in 1923 and the Longstreth Medal in 1925.

Clinton Brettell, superintendent of garages, R. H. Macy & Co., Inc., has been licensed by the New York State Education Department to practice professional engineering. He will consult on fleet and other problems and continue his present work with Macy's.

D. G. Roos, technical assistant to the president, Studebaker Corp., plans to sail for England on Feb. 2. He expects to remain abroad for three months studying foreign design trends.

Charles B. Whittaker resigned his position of Transvaal representative, General Motors South African, Ltd., to join the directorate of Messrs. Pietersburg Garage, Pty., Ltd. He will be located at the Tzaneen Garage, a branch of that concern, at Tzaneen, Transvaal. He had been affiliated with General Motors South African since 1926.

C. B. Whittaker
Changes Companies

Chester R. Wells has joined the Pratt & Whitney Engine Division of United Aircraft Corp., East Hartford, Conn., as an engineer on design. He was previously chief engineer of Rockwell Products Co., of the same city. Mr. Wells is secretary of the Southern New England Section.

J. F. Max Patitz

J. F. Max Patitz, who had been affiliated with the Allis-Chalmers Manufacturing Co. for 42 years, fell dead on Jan. 3 when returning home from visiting the family of an employe who had died recently. The cause was heart shock. For more than 20 years Mr. Patitz had been chief consulting engineer with his company. He was born in Germany in 1866 and after locating in this country became an American citizen. He was made a member of the SAE in 1917.

. . . . At Home and Abroad

Heinrich Schneider has joined the Hooven, Owens, Rentschler Co. in Hamilton, Ohio, as vice-president in charge of Diesel engineering and related activities, and as a member of the board of directors. For the past year he has been assistant vice-president of the American Locomotive Co., Auburn, N. Y. Prior to that he was chief engineer with Fairbanks, Morse & Co.

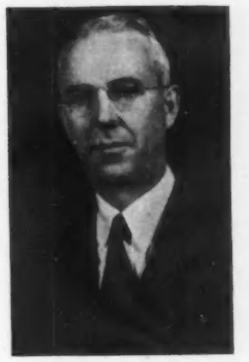
H. Schneider
Vice-President

Vincent Bendix, head of Bendix Aviation Corp., has been made president of the newly-formed Bendix Radio Corp. This company will specialize in radio equipment for communications and navigational purposes for the aircraft industry, with particular attention to blind flying and safety in landing under adverse weather conditions. Plants and laboratories will be located in Chicago, Dayton, Washington and Oakland. *Walter J. Buettner* is treasurer and member of the board of the new company. *Charles Marcus* is on the board.

René Jean-Louis Perrin, formerly general manager, Acieries Electriques d'Ugine, Paris, France, has taken an executive position with Compagnie Française de Raffinage, also in Paris.

Ralph F. Peo, vice-president and general manager of the Houde Engineering Corp. has been elected a director of the Automobile Club of Buffalo.

A. S. Van Halteren, former sales engineer, Motor Wheel Corp., has been made development engineer by that company. He will be located at Lansing, Mich.



A. S. Van Halteren
Advanced

Maurice P. Berger has been named vice-president of the Société des Ingénieurs de l'Automobile (SIA), the French society of automotive engineers, Paris. He was previously secretary-general of the Society.

About Authors

(Continued from page 11)

light-weight high-speed railroad equipment. These are among the many accomplishments of a man who started his career at the age of 17 as machinist's apprentice in Smyrna, Del., the town of his birth.

• **G. O. Hoglund** ***has been delving in aeronautics since 1925 when he was graduated from the University of Michigan with a B.S. degree in aeronautical engineering. He spent his first three years after college as junior aeronautical engineer at the Bureau of Aeronautics, Navy Departent, specializing in design of airplane propellers. For three months in 1928 he did design work on rigid and non-rigid lighter-than-air structures at the Lakehurst, N. J., Naval Air Station. The next year he taught aeronautics at the University of Minnesota. Since then he has spent six years doing development work on welding processes on aluminum with the Aluminum Co. of America.***

• **Fred P. Laudan** ***began his aeronautical career in 1919 when he entered the engineering department of the Boeing Aircraft Co. after returning from Army service overseas. He later became project engineer and in that capacity had charge of the production of 200 Boeing MB-3A Army pursuit planes in 1922. Subsequently he was project engineer for other production orders, including the Boeing Navy fighting planes. In 1928 he was advanced to the post of plant superintendent, his present position. He is a graduate in civil engineering from the University of Washington.***

• **Robert J. Minshall's** ***active interest in aviation dates back to boyhood, when, during high school days at Portland, Ore., he worked in the shop of Eugene Ely, famed aviation pioneer. He first worked for the Boeing Company in its assembly shop in 1918, and in 1919 he joined its engineering department. For the next few years he worked part time while attending the University of Washington from which he was graduated with a degree in civil engineering. He became design engineer in 1928 and is now Boeing's chief engineer. Many Boeing patents bear his name as inventor.***

• **Philip H. Smith** ***has long contributed articles on automotive subjects to business publications. One time associated with the automobile industry in sales and service capacities, he began a career of writing as assistant editor of "Automotive Industries," later engaging in public relations work. He is now a journalist at large, contributing editor to "Scientific American" and special contributor on trailers to "Automotive Industries." He was graduated from Harvard in 1918 with an A.B. degree.***

1937 Annual Meeting Papers in Digest

HERE are digests of all the papers presented at the 1937 Annual Meeting.

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Some of these papers are printed in this issue and others will be printed later in full in the S.A.E. JOURNAL.

Mimeographed copies of *all of them* will be available until current supplies are exhausted, at a cost of 25c per copy to members; and at 50c per copy to non-members, plus 2% sales tax on those delivered in New York City. Orders for mimeographed copies must be accompanied by remittance and should be addressed to Sessions Secretary, Society of Automotive Engineers, 29 West 39th St., New York.

Transportation and Maintenance Session

Monday, January 11

Vehicle Design from a Maintenance and Operating Standpoint – *F. L. Faulkner, automotive engineer, Armour & Co.*

THE purpose of these studies by our committee is to point out inconsistencies that exist in various weight classes, with the hope that a better-balanced vehicle will be produced so that the operator in purchasing a vehicle of a certain rating can be assured of a reasonably uniform performance, irrespective of the make of vehicle.

It is obvious from a study of the 1936-37 specifications that some improvements have been made. The general rating of trucks by class is poor due to the tendency to raise the gross-vehicle-weight rating of the trucks without enlarging engines, clutches, frames, and so on.

In general there is the same wide variation in specifications within each gross class of trucks this year, as existed in 1934.

Larger engines should be provided with higher capacity batteries. Little improvement has been noted in motor-starting characteristics from the standpoint of eliminating starting difficulties under low-temperature operating conditions.

A proposed standard for tractor-trailer coupling heights is outlined.

We recommend the adherence of the S.A.E. numbering system for classification of engine-crankcase oils with such modification as is necessary from time to time to keep them in step with the improvement in refinery practice.

We recommend that all commercial vehicles be provided with a braking system having a minimum of 25 sq. in. effective lining area per 1000-lb. gross vehicle weight.

Fuels and Lubricants Sessions

Monday, January 11

A Sparking Plug, Adapted for Measuring Cylinder-Head Temperatures – *G. D. Boerlage, director in charge, and A. G. Cattaneo, physicist, Royal Dutch Shell Engine-Research Station.*

A NEW method for adapting a spark-plug to the measurement of cylinder-head temperatures is described, consisting in leading thermocouple wires through two holes down through the shell of the spark-plug and bringing them into contact with each other in the surface of the rim exposed to the combustion-chamber.

Engine tests were conducted to compare results obtained by this method of measurement with those obtained with a central-electrode couple, and also a couple incorporated in the spark-plug gasket, all three devices being incorporated in the same plug.

The thermocouple mounted as described in the paper was more responsive to engine detonation than the thermocouple mounted in the gasket but less so than the thermocouple mounted in the central electrode. It was less responsive to changes in wind speed than the gasket couple in the case of an air-cooled engine but more so than the central-electrode couple, and it is believed that a couple mounted as described gives a truer indication of cylinder-wall operating temperatures than can be obtained by either of the other methods.

Analysis of Some Factors Affecting the Relative Knocking Characteristics of Motor Fuels in Service – *John M. Campbell, Wheeler G. Lovell and T. A. Boyd, General Motors Research Corp.*

IN this investigation some of the underlying principles affecting the knocking characteristics of motor fuels in service have been studied. Briefly, the experiments indicate that the relative knocking characteristics of certain cracked gasolines with respect to straight-run gasolines may be affected by the relationship between spark timing, engine speed, and mixture ratio. From the standpoint of engine design the most advantageous combination of these variables in a given engine varies according to the nature of the fuel used.

It is suggested that some of the anomalous characteristics of benzol blends are the result of vaporization phenomena in the induction system, as also are certain "depreciation" effects which occasionally have been observed among straight-run gasolines containing tetraethyl lead.

Effect of Altitude on Octane-Number Determination – *W. M. Holaday and G. T. Moore, Standard Oil Co. of Ind.*

THIS paper reports the results obtained by a small working group of the C.F.R. Subcommittee on Methods for Measuring Detonation in attempting to correct for the effect of altitude on octane-number determination. As the A.S.T.M. (C.F.R.-Motor) knock-test method was worked out for sea-level conditions, experience indicates that errors as large as 2 octane numbers may be produced in laboratories situated in elevated locations.

One logical means of modifying the present method to compensate for altitude is to increase the volume of air admitted to the cylinder until the compression pressure at a given compression ratio is equal to that normally obtained at sea level. It may be effected by supercharging or by removing the restriction in the present carburetor and manifold system by eliminating the throttle plate and enlarging the venturi. Test data are presented that determine the venturi sizes required to give equal compression pressures for altitudes up to 5000 ft. It is shown that knock intensity at different altitudes was uniform and equal whenever the compression pressures were equal.

It is concluded that the errors resulting from the effects of altitude changes on the operation of the A.S.T.M. knock-test engine can be compensated for reasonably well by the use of oversize venturis at the reduced barometric conditions.

Influence of Humidity on Knock Ratings – *J. R. MacGregor, Standard Oil Co. of Calif.*

IT has been assumed generally that variations in humidity would not cause errors in knock rating when using the bracketing method. However, the preliminary test results presented indicate that this assumption is not valid for all fuels. Differences in knock ratings of over three octane numbers were found with certain combinations of test and reference fuels when the humidity was varied over the range normally experienced in knock testing.

It was found that the influence of humidity on detonation is not primarily the result of changes in dry air pressure or oxygen concentration, but apparently depends on the nature of the fuel itself.

The results presented are known to be affected somewhat by changes in engine adjustment and bouncing-pin setting. However, for certain fuels the error introduced by humidity changes is considerably greater than the normal experimental error with controlled humidity. Although for some conventional-type fuels humidity control is not required, it is required when testing certain special fuels, leaded gasolines, and octane-heptane blends.

A description is included of the construction of an engine hygrometer and a humidifier both of which have been found convenient to use in routine testing.

The Effect of Knock Intensity on Fuel Knock Ratings – *Neil MacCoull, The Texas Co.*

THE effect of knock intensity on the knock ratings of four widely different fuels was investigated by a group of C.F.R. members.

Evaluations were made in the laboratories of 19 cooperating companies, on the standard A.S.T.M.-C.F.R. engine, at a compression ratio lower than standard for this method, as well as at a compression ratio higher than standard.

This report, which tabulates and summarizes the data reported, indicates that the type of bouncing pin used may affect the changes in knock rating due to variations in knock intensity resulting from changing the compression ratio of the test engine.

Truck, Bus and Railcar Session

Monday, January 11

Rear-Engine Clutch and Transmission Developments – *C. D. Peterson, Spicer Mfg. Co.*

THIS paper covers the underlying reasoning of the advantages of the rear-mounted engine and transmission for mass transportation and includes special problems in design as regards clutch, transmission, and close-coupled propeller shafts. It also discusses the requirements of the compartment for housing these elements as well as the requirements of maintaining proper operating temperatures.

The paper covers the various developments to date of arrangements for power outlet. Manually and power operated remote-control transmissions and the requirements in transmission and clutch design for either arrangement also are considered.

In some forms of rear-engine-mounted transmission the matter of sealing the transmission is an outstanding problem. A vertical-drive type in a design that has proved satisfactory is commented upon.

Space limitation for mounting the transmission also is a problem, and how various arrangements of the mountings are accomplished is explained.

Factors in Engine Temperature Control – *H. E. Winkler, chief engineer, Schwitzer-Cummins Co.*

MANY comprehensive papers have been presented on the various phases of the cooling problem. Macy O. Teetor's paper on "Cylinder Temperature" and L. P. Saunders' paper on "Radiator Development and Car Cooling" are representative of these.

The treatment of heat in an automotive vehicle presents many complex technical problems but the customer, who understands none of the technicalities, is directly aware of the results. He judges by: (1) How long the engine performs well, (2) How much oil it uses, (3) How often the radiator needs filling, (4) How much noise the fan makes, and so on.

Throughout the entire cooling system, the basic problem is one of rates of heat flow. Temperature balances are reached only when the heat lost by a given spot or system equals the heat absorbed. To have a balance temperature at a safe point, the rate of heat loss must be such that the temperature differential between hot and cold medium need not be too great.

High water velocities are frequently necessary to "scrub" out points where steaming tends to occur. Water pumps serve not only as a circulator within the engine, but also as a train of dump cars hauling B.t.u.'s to the radiator. Water-pump capacity determines the temperature rise of coolant through the engine.

Corrosion in cooling systems is due largely to air being drawn into the coolant at the pump packing or seals. Fan noise is a problem not limited to passenger cars.

Junior-Student Session

Monday, January 11

Electrical Control of Industrial Units – *Ralph Powers, Electronic Control Corp.*

INDUSTRIAL applications of the "electric eye" or photo-electric cell are discussed in non-technical language in this paper, and how they solved various problems.

Operating principles and specific applications of the photo-conductive or selenium group, the photo-voltaic group – those producing their own electromotive force – and the photo-emissive group, are described fully.

On-and-off relay applications – such as used for starting and stopping conveyors, counting, routing, and opening doors – are classified as the simplest. It is believed that photo-electric temperature control will soon overshadow older methods, especially for heat-treating, metal pouring, and the like. Color control and automatic inspection are other important applications covered.

The Engineer's Social Responsibility – *Dr. James S. Thomas, Chrysler Institute of Engineering and Clarkson College of Technology.*

THIS paper discusses the engineer's place in our social set-up. It cites instances of the application of science to our Western civilization and how this application is not evident in the Oriental world.

Interesting information is presented on the importance of being young in order to grow up with the important scientific changes that are going on. The necessity for the proper education to meet these changes is emphasized.

Tourist-Trailer Session

Tuesday, January 12

Where Is the Trailer Going? – *Philip H. Smith.* (Paper published in full, beginning on page 45, Transactions Section, this issue.)

Diesel-Engine Session

Tuesday, January 12

Correction of Diesel-Engine Performance for Changes in Atmospheric Conditions – *C. Fayette Taylor, professor of automotive engineering, Massachusetts Institute of Technology.*

THIS paper refers to previous literature on the subject and discusses the fundamental factors involved. It also gives the results of tests showing the effect of variations in atmospheric pressure and temperature on one particular engine. In conclusion it points out the need for further research on this subject.

Compression-Ignition Engine Performance at Altitude Conditions – ***Charles S. Moore, assistant mechanical engineer, and John H. Collins, Jr., junior mechanical engineer, National Advisory Committee for Aeronautics.***

ENGINE-TEST results are presented for simulated altitude conditions using a displacer-piston combustion-chamber on a 5-in. by 7-in. single-cylinder compression-ignition engine operating at 2000 r.p.m.

Comparison between maximum performance at altitude of the compression-ignition engine and a carburetor engine showed that the compression-ignition engine had a slight power advantage for the same conditions of inlet air. However, if the carburetor air is heated to prevent icing, the compression-ignition engine inducting the colder and more dense air of altitude will have a decided advantage over the carburetor engine.

Analysis of the results for which the inlet-air temperature and pressure were varied independently indicates that maximum engine performance cannot be corrected reliably either on an inlet-air-density or weight-of-air-charge basis. Maximum engine power increases with inlet-air pressure and decreases with temperature very nearly as straight lines. Correction factors are suggested accordingly.

Automotive High-Speed Diesel Engine in Heavy-Duty Transport – ***C. G. Anthony, Pacific Freight Lines.***

THIS paper offers facts and conclusions drawn from actual cost figures. The relative costs of operating Diesel-powered, heavy-duty trucking equipment as compared with like equipment over the same runs, but using gasoline engines for power, are developed.

The economic sphere of utility of the Diesel engine in transport service is determined by comparing Diesel costs with the costs of the competing agencies – water, rail, and gasoline-motored equipment.

The conclusions show that the economy of a Diesel-powered motor truck at its present stage of development is the result of its low fuel consumption from the standpoint of gallonage, and the relative cheapness of the fuel used.

With the exception of this lower operating cost of fuel and depreciation, which is higher for the Diesel-powered equipment, all other costs incurred in operating these Diesel-powered units were approximately equal to the costs for similar material or services used in gasoline-powered vehicles. Diesel-powered equipment is cheaper than water, rail, or gasoline-motored trucks within certain definite limits.

Due to the fact that the saving in fuel cost is so large, this paper shows that the cost of operation of heavy-duty trucking equipment can be reduced very substantially when Diesel engines are used.

Passenger-Car Safety Session

Tuesday, January 12

Relating Highway Planning to the Traffic Requirements – ***T. H. MacDonald, chief, and H. S. Fairbank, chairman of the research committee, U. S. Bureau of Public Roads.***

THIS paper describes the evolution of the country's present highway system, pointing out how ever-changing traffic requirements brought about by the rapid development of the automobile complicated highway planning to such an extent that requirements would change frequently before a system was completed.

Sharp curves, short sight distances, and narrow widths are named as the worst faults of the present system, most of which was designed for 40 m.p.h. instead of prevailing higher average speeds. The need for separated lanes and continued elimination of grade crossings and highway intersections is stressed. The authors also recommend either that grades be reduced materially, or that the automotive engineer raise the hill-climbing ability of freight trucks.

The necessary financing presents the most serious obstacle in the way of such improvements. The purpose and operation of State-wide highway planning surveys are explained in considerable detail, as are those of the financial studies that follow.

An Automotive Engineer Looks at Safety – ***W. J. Davidson, General Motors Corp.***

ALTHOUGH total fatalities for 1936 probably will exceed slightly those for 1935, the rate based on the number of miles traveled will show a downward trend as 1936 usage shows a 10 per cent increase.

All accidents involve three factors: the highway, the human factor, and the car. Of these the car is responsible for about 10 per cent of accidents, leaving 90 per cent for the other two factors.

The need for comprehensive nation-wide data to assist engineers in analyzing the causes of mechanical failure, is stressed. From a safety standpoint the automobile is divided into two general classifications – those items that affect maneuverability and control and those of the structure itself. The features under the heaviest fire in the maneuverability classification are top speed and headlamps. Such items as steering-gear failures, bursting tires, and so on, come under the heading of the structure itself. The effect on safety of governing cars to limit their top speed is highly questionable. With headlamps the problem is to get plenty of light and, at the same time, to provide adequate glare relief.

Compulsory inspection will contribute materially to the cause of safety – at least in a psychological way.

Diesel-Engine Session

Wednesday, January 13

Diesel Engines in Trucks – ***B. B. Bachman, The Autocar Co.***

THE author makes a brief recapitulation of the paper that was presented at the Metropolitan Section of the Society last spring and carries through an analysis of reports that have been received on the operation of some 30 of these units both in the East and on the West Coast.

The discussion covers the general operating characteristics of these units together with a further study of a comparison between two Diesel units and a gasoline unit from the basis of operating cost.

Cetane Numbers, Life Size – ***Lieut. Com. R. F. Good, U. S. Naval Engineering Experiment Station.***

FOR the past two years the U. S. Naval Engineering Experiment Station at Annapolis, Md., has been carrying on a Diesel fuel investigation having for its primary purpose the preparation of specifications for a single grade of Diesel fuel which will satisfy the requirements of all Naval Diesel engines except those for aviation use.

Ignition quality is a property inherent in a Diesel fuel itself. Ignition delay, the fundamental manifestation of ignition quality in the running engine, is not a characteristic of the fuel alone but a property of the entire system, including not only the fuel, but the engine in which the fuel is burned. Ignition delay, therefore, can be considered as only one of several factors which, taken together, determine the effectiveness of fuel utilization. Recognition of these facts led to an extended series of tests in a full-scale, submarine-type test engine operated under service conditions.

Specifically, the paper records the ignition delay, fuel consumption, and computed knock for a large number of test fuels representing the major geographical producing areas, and for blends of primary and secondary reference fuels as observed in the full-scale engine. From the ignition-delay data for primary fuels and test fuels the "life-size" cetane numbers of the latter are determined. The degree of correlation between the "life-size" cetane numbers and the ignition-quality indexes of the test fuels calculated from their physical and chemical properties and as measured in the standard C.F.R. Diesel knock-testing engine by the knockmeter-delay method, is discussed.

Passenger-Car Body Symposium

Wednesday, January 13

The Aircraft Trend in Body Structural Design – ***Edward G. Budd, president, Edward G. Budd Mfg. Co.*** **(Paper published in full, pages 65-66, Transactions Section, this issue.)**

The Chassisless or Unit Car Question – ***Stanley E. Knauss, Motor Coach Division, Gar Wood Industries.***

THE experience gained over a period of many years in the development of light-weight, high-strength structures is now finding its way into the bus industry.

Investigation of present-day bus operations showed the need for a road vehicle that would carry the greatest possible payload of passengers with a smaller horsepower engine without dragging along a load of dead weight and useless structure that would eat up gasoline instead of miles.

A motor coach is now available in which is incorporated aircraft materials, design, and construction features resulting in a vehicle that is approximately 1000 lb. lighter than the lightest conventional design with the same engine horsepower and seating accommodations.

Motor-bus operators today can reduce costs by the use of light-weight equipment provided there is no sacrifice of strength and reliability. They must also meet the ever-increasing demands of the public for quietness, comfort, absence of vibration and engine odors – all of which can be accomplished by placing the engine in the rear which automatically gives a better distribution of weight than has heretofore been possible with the front-engine design.

Criticisms From the Aircraft Viewpoint – *Ralph H. Upson, aeronautical engineer.*

AIRCRAFT have taken more from automobile design than they have given, but they can now repay much of the obligation without necessarily transgressing the requirements of production economy and reasonable design stability. Some of these possibilities are:

(1) Improved streamlining of necessary exposed parts, particularly underneath, and incorporation of other accessories in the general body lines.

(2) Use of curved glass in the windshield and lightening of all window material.

(3) Reduction of the frame to the status of an assembly unit, with structural significance only in combination with the body.

(4) More effective distribution of flange material around the doors.

(5) Lightening of skin by use of internal stiffeners, particularly on top.

(6) Development of a smaller, more efficient radiator and lightening of various engine parts.

Most important is the mental attitude behind the work. Phenomenal production economy has been attained because almost every man in the industry has concentrated on it. Worthwhile weight and drag reduction would result if even one competent man were assigned specifically to that duty.

Lightening, with streamlining, is a beneficent cycle that permits still further lightening, resulting directly in substantial operating economies and, indirectly, in lower production cost.

The Probable Effect of Unit Automobile Body Construction on Insurance Rates – *Howard D. Brown, general attorney, Detroit Automobile Inter-Insurance Exchange.*

COLLISION and property-damage insurance rates are based on the cost of carrying such risks plus a reasonable amount for administrative purposes. Insurance companies develop what is known as a pure premium which only includes the cost of replacement and the repairing of insured automobiles suffering losses. To this pure premium is added a sufficient cost for administration and profits. Since insurance rates are determined by actual costs for repairs and replacements, it naturally follows that, if the cost of repairs and replacements increases, insurance rates must also increase. An attempt is made to show repair costs in the past and those that may be anticipated reasonably if unit body construction is adopted.

The element of service to the public through insurance also is a primary factor. If the automotive industry were to adopt for use the unit-body construction, it also would be necessary that adequate facilities be at hand throughout the various cities and rural districts of the nation to render adequate service. Delay to the public because of inadequate service facilities and the inaccessibility of repair parts would tend to build up public resistance. The question also arises whether or not in case of damage the unit-body construction can be repaired as quickly and cheaply as the present type of body.

From the insurance viewpoint, the crux of the entire question is whether or not the cost of repairs in case of accident will be increased by the adoption of the unit body. If this increase is so, naturally insurance rates on collision and property damage also will increase.

Ring-Sticking Symposium

Wednesday, January 13

Observations on Cylinder-Bore Wear – *Max M. Roensch, Chrysler Corp.*

IN analyzing causes of cylinder-bore wear it is found that they fall generally into one of the following classifications:

(1) Abrasion – Wear due to foreign particles in the oil film.

(2) Erosion – Wear due to metal contact between the pistons or rings and the cylinder bore.

(3) Corrosion – Oxidization or chemical action of the cylinder wall by the products of combustion.

Although these classifications place the three main factors in the approximate order of their importance, the conditions of operation, the design of the engine, the design of the air cleaner, piston and ring equipment, or lubricating oil used, may change the order completely.

Four ways are described for abrasives to get into the engine, and three design factors are mentioned that will reduce cylinder wear in the presence of dust. Keeping the dirt out, however, is stated to be the only real solution, and air cleaners are recommended as the best method.

Ample space is devoted to a discussion of erosion and corrosion with various causes and cures.

A Mechanical Solution of the Diesel Engine Piston-Ring-Sticking Problem – *A. W. Pope, Jr., Waukesha Motor Co.*

EXTENSIVE field and laboratory tests lead to the conclusion that piston-ring sticking is chiefly the result of high temperatures. Most commercial lubricating oils available on the market show definite tendencies to stick piston-rings when operated in high-speed Diesel engines at high load factors.

As no practical method of keeping maximum temperatures within the necessary limits to prevent ring-sticking is known, the problem has been approached from the viewpoint of mechanical design. A simple one-piece ring design has been found that successfully solves the ring-sticking problem.

This solution tends to change the relative order of importance of lubricating-oil qualities so that an oil's ring-sticking tendency may become secondary compared with its lubricating ability and freedom from sludging.

Engine Temperature as Affecting Lubrication and Ring Sticking – *C. G. A. Rosen, Caterpillar Tractor Co.*

IN the investigation of combustion in Diesel engines considerable emphasis was placed upon temperatures prevailing in metal parts adjacent to the combustion-chamber envelope. In mobile-type Diesel engines these temperatures are influenced directly by design characteristics, service conditions, atmospheric temperatures, and operating schedules. Of particular importance is the combined effect of the factors upon piston temperatures and, therefore, of direct consequence to lubrication.

Oxidation tests of lubricating oils for metals have demonstrated that gummy and carbonaceous products are deposited in relation to the heat gradient in the piston, particularly in the ring-belt region. The type and extent of these deposits is influenced further by the source of the crude and by the method of treatment and of finishing the lubricating-oil stock.

The gummy deposits from the lubricating oil act as binders to congeal carbon and dust in the ring-grooves to produce ring sticking. Even though mechanical construction and thermal regulation can provide some alleviation for ring sticking, the great variety of service, operating, and atmospheric-temperature conditions encountered in Diesel tractors operating throughout the world calls for specialized lubricants.

This paper deals with the program of investigation of the influence of engine temperature on lubrication and ring sticking and the development of improved lubricants for high-duty Diesel service.

The Problem of Ring Sticking in Aviation Engines – *Dr. O. C. Bridgeman, National Bureau of Standards.*

THE problem of ring sticking in aviation engines is unusually complicated due to the lack of standard test methods and to the difficulties in obtaining reproducible data on full-scale engines. In fact, the immediate problem is largely one of developing suitable test equipment and methods. As soon as such a method is developed, coordination of activities by different groups becomes possible, and the problem will be well on its way towards solution.

In common with most lubrication problems, ring sticking involves the inseparable trio of variables, namely oil characteristics, engine-design factors, and operating conditions. During the early stages of aviation, ring sticking was largely the result of the use of oils of inferior stability, such as vegetable oils and blends of these oils with mineral oils. Since that time there has been such a rapid improvement in oil stability and such a rapid increase in engine horsepower that engine-design factors are of much greater importance than previously. Aviation oils are

now so stable at high temperatures that the older type of ring sticking seems to have passed entirely out of the picture.

As far as oil characteristics are concerned, the ring sticking of today in high-output aviation engines is tied up with so-called "oiliness" as well as stability. Although ring sticking in many of these engines probably can be minimized by alterations in design, present indications point to the necessity for using compounded oils of high oiliness and stability if satisfactory ring performance is to be obtained in engines of higher horsepower per cubic inch displacement than those in use at present.

Tractor Session

Wednesday, January 13

The Tractor - Brother to the Automobile - *V. P. Rumely, Hudson Motor Car Co.*

INCREASED demand in the farm field, and ever-expanding applications in industrial, construction, and military fields are forecast for the tractor. Factors that will increase the demand for farm tractors are enumerated as crop diversification, flood control, and the scientific development of new farm products for industry, such as tung-oil nuts and soy beans. The rapid motorization of the armies of the world is pointed out to show the tractor's rapidly growing applications in the military services.

In design the automobile engineer has been confronted principally with higher speeds and medium or low pressures, whereas the tractor engineer has to deal with low or medium speeds and high pressures.

Problems common to both tractor and automobile are discussed, pointing out the valuable pioneering work done by the tractor industry on items such as air cleaners.

The Cavalcade of Farm Mechanization - *Harry G. Davis, director of research, Farm Equipment Institute.*

MOST people accept modern mechanization as a matter of fact and never stop to think that most of the things that they hold near and dear are, in reality, the fruits of it.

Although farm machinery has wrought most wonderful changes in agriculture, itself, its effect upon general welfare is still greater because its influence extends to every branch of our national economy. It is impossible for anyone to be so far removed from the farm as to be free from the effect of agricultural mechanization. If every farm machine were to be legislated out of existence today, and we were compelled to turn back to conditions as they existed in 1820 when it required 215 agricultural workers per 1000 population, 17,000,000 people would have to give up their present occupations, grab spades and hoes, and start to grow their own food and clothing material. If this transition resulted in employment in non-agricultural occupations of only 43 persons per 1000 population, as was the case in 1820, 17,000,000 more would have to give up their jobs and join the vast army of unemployed.

Consider the elimination of one machine, the cotton gin, for instance. If we were to do away with this machine and did not reduce our production below the average of the past ten years, it would require 37,000,000 people, working 8 hr. per day for 300 days per year to separate by hand the seed from the lint.

"The cavalcade of farm mechanization" will continue its onward march until American agriculture is mechanized completely, farm products are produced at the lowest possible cost, and the social and economic position of all our people, as well as of our farmers, is greatly improved.

Passenger-Car Engine Session

Thursday, January 14

Powerplant Possibilities of the Immediate and the More Remote Future - *P. M. Heldt, technical editor, "Automotive Industries."*

THIS paper is in two parts. Part I relates to improvements that are likely to be made in engines for passenger cars of the standard conventional chassis layout. It is pointed out that designers will endeavor to improve these engines so as to obtain greater output per unit of displacement and per unit of weight, to increase the fuel economy and the service life. Specific outputs will be increased by increasing the compression pressure and the peaking speeds of the engines.

These changes cannot be made without running into certain difficulties, and the paper points out some of the means of overcoming these difficulties. Fuel economy also can be improved by using hotter sparks (longer spark gaps) and by spark-timing control in accordance with the inlet-manifold depression, and both of these features are discussed. To reduce cylinder wear it is essential to warm up the engine as quickly as possible when starting from cold and to supply lubricant to the cylinder walls as quickly as possible, and both of these problems are discussed. The possibility of direct fuel injection in automobile engines with a view to improving the economy and the need for cutting down the oil consumption at high engine speeds also are referred to.

In Part II of the paper engines suitable for chassis with unusual layouts, such as a front-mounted powerplant with front drive or a rear-mounted powerplant with rear drive, are dealt with. It is pointed out that, if the present tendency to reduce the overall height of cars continues, it will not be many years before the longitudinal propeller shaft extending underneath the body will have to be eliminated by having the powerplant and the drive both at the same end of the car. This arrangement calls for a more compact powerplant than the present conventional types, and various possible types are analyzed with respect to spacing of explosions and freedom from primary and secondary inertia forces and couples. Radial "V" and "W" and flat engines are covered in this survey.

Passenger-Car Lubrication Session

Thursday, January 14

Hypoid Rear Axle Design and Lubrication - *W. R. Griswold, chief research engineer, Packard Motor Car Co.*

CONSIDERABLE effort is made in this paper to explain the nature of hypoid gears and try to convey some idea of why straight mineral oils are not suitable and that special oils are required. The author tells of the effort made by the axle designer and the manufacturer to attain, as nearly as possible, perfection in building the axles, pointing out that all the benefit of this work can be lost by the use of an unsuitable lubricant.

Hypoid gears and their tooth action are compared with preceding types. Gear mountings are described, explaining the advantages of making them rigid. The influence of the lubricant used on load capacity and wear of hypoid gears is explained in considerable detail. Characteristics of suitable E.P. lubricants are discussed with recommendations for their proper selection.

Aircraft Session

Thursday, January 14

Spotwelding and Seamwelding the Aluminum Alloys - *G. O. Hoglund, Aluminum Co. of America.*

(Paper published in full, pages 57-65, Transactions Section, this issue.)

Gust Loads on Airplanes - *Richard V. Rhode, National Advisory Committee for Aeronautics, Langley Field.*

THE concept of a "sharp-edged" gust in which the wing is assumed to obey the laws of steady flow has proved useful as a temporary expedient in setting up design criteria for gust loads. However, the trend toward construction of large, heavily loaded transport airplanes and the problem of the light airplane require further rationalization of these criteria.

Present indications of extensive acceleration data obtained on the relatively small transports of the domestic airlines and on the large Clippers of the Pan American Pacific and Caribbean routes harmonize with theoretical indications that current design criteria are underconservative for heavily loaded airplanes and over-conservative for lightly loaded ones. Occasional records of acceleration in very strong gusts such as occur in line squalls, emphasize the necessity for avoiding severe weather conditions.

Ocean Air Transportation - *L. C. McCarty, Jr., The Glenn L. Martin Co.*

THIS paper presents a comprehensive study of the progress made in ocean air transportation with particular application to the coming struggle for supremacy in the North Atlantic trade.

The leading items of pioneering work are reviewed from the NC crossing in 1919, to the recent experiments of the Dornier "Aeolus" under the German flag.

The accomplishments of Pan American with Martin Clippers on the San Francisco-China route are analyzed, and data are given concerning the British, French, and German types now being prepared for the trans-atlantic service, with comment on the various routes and methods under consideration.

The detailed specifications and characteristics of new designs now in process for ocean airplanes up to 250,000 lb. gross weight are disclosed in this paper, with data relating to operating costs and revenue.

Charts are shown giving data of range vs. cargo, relative effect of head winds, effect of frequency of schedules, and efficiency factors. Information is presented concerning the relation of payload to airplane size, and the ratio of cost of airplanes per pound of payload, as the amount of payload increases.

The subject of comfort and convenience to passengers is discussed, with special reference to high-altitude flying in "pressure cabins" and the resulting independence of weather.

Data and discussion are offered on the relative usefulness of the large flying boat as compared with the rigid airship. The probable effect of the growth of aircraft transportation from the United States to Europe upon the older mode of steamship transportation is predicted with particular reference to the carrying of high-tariff passengers and mail.

The paper concludes with a forecast of the progress in trans-atlantic air transport which, from the author's knowledge of the situation, appears to be in immediate prospect.

Annual Meeting Dinner

Thursday, January 14

The Airship and Its Place in Modern Transportation – *Dr. Hugo Eckener, chairman of the board, German Zeppelin Transport Co.*

THIS paper discusses the position of the airship as a means of transportation, briefly reviewing the history of the supposed but really non-existing competition between the airship and the airplane.

The results of the "Hindenburg's" ten North Atlantic demonstration trips of 1936 are reported on and the meteorological experiences made are discussed. Figures of cost of operation and revenues of the Hindenburg are revealed, showing the relatively low cost of operation of the modern passenger airship.

The relative places of the express steamer, the airship, and the airplane in the future North Atlantic transport picture are discussed, and the necessity for cooperation between Germany and the United States in the future development of the airship is emphasized. The active cooperation particularly of engineering circles in the United States is suggested.

Aircraft-Engine Sessions

Friday, January 15

Aircraft-Engine Materials – *J. B. Johnson, Materiel Division, U. S. Army Air Corps, Wright Field.*

THIS paper is prepared in the form of a compendium of the several materials, ferrous and non-ferrous, that are employed in the construction of aircraft engines. The data are arranged in tables giving the specifications and applications for the several metals, with descriptive matter covering the metallurgical reasoning which led to their adoption.

The limitations of the properties of the materials are stated, and suggestions made for changes in design which would permit the application of other materials. The evolution that has taken place in the development and application of metals to meet the demand of increased performance is illustrated.

High Output – and How? – *Val Cronstedt and Ralph N. DuBois, Aviation Mfg. Corp., Lycoming Division.*

THE increasing availability of aviation fuels of very high knock rating makes it advisable to study the methods of utilizing these fuels to obtain high specific output.

For a given horsepower output the relative advantages of high cylinder compression ratio, high supercharger compression ratio, and high crankshaft speed are compared.

The conclusion is drawn that, for long-range aircraft, high cylinder compression ratio with moderate supercharging is superior whereas, for short-range equipment, it is advisable to use moderate compression ratios and highly supercharged engines. The advantages of high crankshaft speed are best obtained in the latter type of aircraft.

The Measurement of Engine Friction – *Milton K. McLeod, Massachusetts Institute of Technology.*

THE measurement of actual operating engine friction by means of a motoring test has certain inherent errors. Among these errors are:

(1) Cylinder and piston temperature changes, which affect the viscosity of the lubricant and thus the piston friction.

(2) Piston and ring load changes, which affect piston side load and, thus, piston friction.

(3) Exhaust-pressure changes, which affect the pumping friction.

(4) Contamination and burning of oil on cylinder walls during firing runs, which is not present in motoring runs and, thus, affects piston friction.

(5) Engine friction as determined on a dynamometer changes with time when measured immediately after a firing run.

A possible way to eliminate these errors is to measure, during an actual run, both the indicated mean effective pressure by means of an indicator card and the brake mean effective pressure from the dynamometer, the difference between these being the friction mean effective pressure. It is also possible by the use of light-spring indicator cards to determine the effect of operating variables on the mechanical and pumping friction separately.

This method has the advantage of being a measurement of engine friction during the actual operation of the engine and, as such, eliminates the preceding errors.

Production Session

Friday, January 15

Developments in Close Machining Practice in Automotive Production – *Fred C. Pyper, master mechanic, Buick Motor Co.*

THE author points out that the policy of manufacturers in sharing their experience has been an important factor in the development of modern machines and equipment without preventing diversity of the product.

The old practice of fitting parts when assembled was expensive, and the product was inferior.

Development of special machines for multiple as well as single operations resulted in greater accuracy and economy. Examples are cited of boring, turning, and broaching operations, balancing and grinding parts, and other operations and the high degree of accuracy obtained are described.

Finally the paper points out the necessity for highly accurate cutting tools and fixtures, the new practices that are possible with highly developed materials such as carbide cutting tools, and so on, and that the way is still open for much further progress.

Budgeting Expense and Cost of Handling Materials in Automotive Plants – *George Miller, budget supervisor, Chrysler & Chrysler-Kercheval Plants, Chrysler Corp.*

TO carry out an effective method of expense control in the manufacturing division in automotive plants, it is first necessary to translate the manufacturing program as it applies to the various departments into estimates of cost, and then to perfect a positive control.

What is meant by a positive control is catching the expense before the money is spent; any other method as applied to budget work could naturally be termed "remote control."

Establishments of standards is the first consideration.

Maintaining the necessary statistical data so that a daily and accumulative record of progress of actual expense as compared to the budget is the next consideration.

The method of dealing with those responsible for the spending of money for labor, supplies, and so on, is one of the most important considerations.

The handling of materials in an automotive plant is a costly item. Cost of supplies and tools must be watched closely and controlled effectively. These items are elaborated upon.

Personnel of 1937 SAE Committees

PRESIDENT HARRY T. WOOLSON announces the following appointments on the Administrative Committees of the Society and the personnel of the Professional Activities, Technical and Special Committees for 1937.

These include the Research Committee and its Subcommittees, the Standards Committee and its Divisions, the Society's Special Committees and Cooperative Committees on which the Society is represented with other organizations. Acceptance of their appointment has been received from virtually all of those named.

(An asterisk in the following listings indicates a non-member of the Society who has been invited to serve.)

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F. P. Hall, Jr.
J. Harold Hunt
O. A. Parker
E. B. Ross

† This committee also acts as the Standardization Policy Committee.

BALL AND ROLLER BEARING DIVISION

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Ernest Wooler, *Vice-Chairman*

D. F. Chambers
L. A. Cummings
T. C. Delaval-Crow
A. E. Fawley
H. R. Gibbons
H. T. Morton
H. N. Parsons
H. R. Reynolds
H. A. Schatz
J. S. Tawresey

DIESEL-ENGINE DIVISION

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E. T. Vincent, *Vice-Chairman*

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C. L. Cummins
John Dickson
Max Hofmann
*L. T. Knocke
W. A. Parrish
W. H. Radford
E. B. Rawlins
M. J. Reed
L. P. Saunders
O. D. Treiber

ELECTRICAL EQUIPMENT DIVISION

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C. F. Gilchrist, *Vice-Chairman*

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R. H. Combs
R. M. Critchfield
*Harry Doane
K. A. Eger
P. J. Kent
E. K. Schadt
*T. E. Wagar

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J. B. Fisher, *Vice-Chairman*

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H. M. Bramberry
C. E. Frudden
A. W. Lavers
A. F. Milbrath
W. A. Parrish
*Max Roensch
H. G. Smith
J. C. A. Straub
V. C. Young

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E. F. Davis, *Vice-Chairman*

J. R. Adams
A. H. d'Arcambal
*A. L. Boegehold
*H. Bornstein
H. T. Chandler
*Bishop Clements
A. T. Colwell
*W. E. Davis
B. H. DeLong
N. L. Deuble
H. J. Fischbeck
H. W. Graham
*W. J. Harris
A. J. Herzig
*W. G. Hildorf
E. J. Janitzky
*J. B. Johnson
G. E. Knable
H. B. Knowlton
F. E. McCleary
O. W. McMullen
J. G. Morrow
H. T. Morton
R. B. Schenck
E. W. Upham
J. M. Watson
T. H. Wickenden
Henry Wysor

LIGHTING DIVISION

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R. E. Carlson, *Vice-Chairman*

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A. W. Devine
*H. C. Doane
R. N. Falge
*C. L. Holm
R. W. Johnson
P. J. Kent
G. W. Keown
V. J. Roper
A. N. Taylor
*J. T. Wadkins
*T. E. Wagar
*Sidney Williams

LUBRICANTS DIVISION

E. W. Upham, *Chairman*

H. C. Mougey, *Vice-Chairman*

D. P. Barnard
Sydney Bevin
W. G. Clark
A. L. Clayden
Harte Cooke
E. F. Davis
*C. E. Earle
F. L. Faulkner
J. B. Fisher
H. F. Fritch
C. E. Frudden
J. C. Geniesse
F. K. Glynn
H. C. Gooch
W. H. Graves
L. B. Helm
W. S. James
H. T. Kennedy
F. F. Kishline
*F. D. Klein
H. B. Knowlton
C. M. Larson
B. O. Lewis
R. P. Lewis
L. C. Lichty
W. W. Lowe
K. G. Mackenzie
A. G. Marshall
G. M. Maverick
*J. L. McCloud
Elmer McCormick
*H. A. McConville
Gordon McIntyre
G. L. Neely
H. M. Northrup
F. J. Philippbar
D. G. Proudfoot
G. A. Round
W. A. P. Schorman
B. E. Sibley
J. L. Stewart
R. E. Wilkin

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T. F. W. Meyer, *Vice-Chairman*

*Frank Fernstrum
H. E. Fromm
A. W. Hagan
*W. M. Horn
F. T. Irgens
R. Karey
*Walter Leveau
Richard Wastcoat

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M. C. Horine, *Chairman*

F. L. Sage, *Vice-Chairman*

F. G. Alborn
C. O. Ball
W. J. Cumming
F. L. Faulkner
J. B. Fisher
Adolf Gelpke
C. O. Guernsey
A. W. S. Herrington
C. D. Peterson
W. D. Reese
H. E. Simi

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W. H. Graves, *Vice-Chairman*

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*John A. Gann
*C. R. Ince
*H. C. Jennison
*J. B. Johnson
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*C. H. Mathewson
C. R. Maxon
*J. L. McCloud
*W. E. McCullough
H. C. Mougey
J. V. O. Palm
*W. B. Price
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A. E. Weiss
T. H. Wickenden

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Elmer McCormick, *Vice-Chairman*

W. L. Barth
Arthur Boor
A. T. Colwell
G. L. McCain
H. M. Northrup
C. W. Spicer
W. R. Spiller
William Wagstaff
J. J. Wharam
F. G. Whittington

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G. L. McCain, *Chairman*
F. F. Kishline, *Vice-Chairman*

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W. L. Barth	E. S. MacPherson
R. E. Cole	H. M. Northrup
G. A. Delaney	E. H. Smith
G. H. Freers	J. J. Wharam

PRODUCTION DIVISION

D. A. Wallace, *Chairman*
W. B. Hurley, *Vice-Chairman*

C. A. Borton	W. P. Michell
J. E. Hacker	E. N. Sawyer
R. B. Haynes	*J. A. Siegel
W. H. McCoy	E. R. Smith

SCREW-THREADS DIVISION

E. H. Ehrman, *Chairman*
Earle Buckingham, *Vice-Chairman*

Arthur Boor	G. S. Case
E. J. Bryant	G. T. Doman
G. Carvelli	*S. B. Terry

*E. M. Whiting

TRACTOR AND EQUIPMENT DIVISION

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W. H. Worthington, *Vice-Chairman*

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O. E. Eggen	C. D. Peterson
J. S. Erskine	R. M. Schaefer
*S. W. Gray	W. F. Strehlow

*Benjamin Van Zee

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F. K. Glynn, *Vice-Chairman*

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W. J. Cumming	H. E. Oszman
J. A. Harvey	E. S. Pardoe
H. R. Holder	T. C. Smith
Adrian Hughes	M. F. Steinberger
A. A. Lyman	E. C. Wood

COMMITTEE ON METHODS OF EXPRESSING LIMITS AND TOLERANCES

Earle Buckingham, *Chairman*

E. H. Ehrman C. W. Spicer

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J. H. Hunt, *Chairman*

*G. C. Arvedson M. W. McConkey

STANDARDIZATION POLICY COMMITTEE

(See General Standards Committee.)

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R. S. Begg	E. H. Hamilton
T. P. Chase	M. C. Horine
A. F. Coleman	W. S. James
Burns Dick	S. Johnson, Jr.
H. C. Dickinson	Karl Pfeiffer
C. L. Eksergian	T. D. Pratt
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A. S. Van Halteren

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A. K. Brumbaugh	J. A. Packard
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F. K. Glynn	W. D. Reese
A. G. Herreschoff	E. W. Winans

A. M. Wolf

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(In cooperation with the Ordnance Dept. U. S. Army)

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W. G. Wall, *Vice-Chairman*

C. J. Bock (Alternate for G. A. Green)	H. T. McDonald (Alternate for Paul Weeks)
L. R. Buckendale (Alternate for H. W. Alden)	E. F. Norelius
	G. A. Round
G. A. Green	A. J. Scaife
J. E. Hale	A. W. Scarratt (Alternate for E. A. Johnston)
A. W. S. Herrington	
Robert Insley	
E. A. Johnston	Paul Weeks

PLACEMENT COMMITTEE

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J. A. Anglada	Walter Howard
J. C. Armer	C. F. Lautz
R. E. Carlson	Reese Lloyd
C. L. Drake	J. R. MacGregor
P. W. Eells	R. W. Mann
W. B. Ensinger	C. H. Paxton
A. B. Gardner	Wm. Schwarze, Jr.
F. P. Gilligan	J. Weinfield

Herman Winkler

OVERSEAS RELATIONS COMMITTEE

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W. L. Batt	H. H. Kelly
B. C. Foy	Alvan Macauley
P. M. Heldt	J. D. Mooney
A. W. S. Herrington	G. S. Piroumoff

Canada

J. L. Stewart

Resident Overseas

A. A. Adams	Bruno Grassi
I. K. Black	D. F. Myers
S. E. Dithmer	P. E. West

Australia

James Fielder

Europe

G. D. Boerlage	Gustave Joassart
J. F. Buss	Gustaf Larson
Peter Carp	E. C. Rassbach
A. H. R. Fedden	Alexander Senkowski
Ugo Gobbato	Milos Smejkal
Maurice Goudard	Alex Taub
W. R. Hamer	Othmar Windberger
J. J. Ide	

Memorial Committees

MANLY MEMORIAL MEDAL BOARD OF AWARD

A. H. Roy Fedden, *Chairman*

S. D. Heron C. F. Taylor

AWARDS

1928 S. D. Heron
1929 No award
1930 O. C. Bridgeman
1931 No award
1932 F. L. Prescott
1933 A. H. Roy Fedden
1934 Rex B. Beisel, A. Lewis MacClain, F. M. Thomas
1935 G. E. Beardsley, Jr.

WRIGHT BROTHERS MEDAL BOARD OF AWARD

E. P. Warner, *Chairman*

AWARDS

Carleton E. Stryker S. J. Zand

1928 C. H. Havill
1929 R. H. Upson
1930 T. P. Wright
1931 S. J. Zand
1932 E. P. Warner
1933 E. N. Jacobs
1934 Rex B. Beisel, A. Lewis MacClain, F. M. Thomas
1935 William Littlewood

Representatives on Other Organizations and Committees

ADVISORY BOARD OF THE GOVERNMENT TECHNICAL COMMITTEE ON LUBRICANTS AND LIQUID FUELS

C. F. Kettering

AMERICAN BUREAU OF WELDING

E. J. W. Ragsdale

AMERICAN COMMITTEE ON THE MARKING OF OBSTRUCTIONS TO AIR NAVIGATION

G. W. Lewis

AMERICAN FOUNDRYMEN'S ASSOCIATION

ALLOY CAST IRON COMMITTEE

F. E. McCleary

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

RESEARCH COMMITTEE ON CUTTING OF METALS

W. H. McCoy
*E. H. Johnson (Alternate)

AMERICAN SOCIETY FOR TESTING MATERIALS

COMMITTEE A1 ON STEELS

F. P. Gilligan

SUBCOMMITTEE VIII ON STEEL CASTINGS

F. P. Gilligan

COMMITTEE E11 ON CHEMICAL ANALYSIS OF METALS

J. R. Adams

SUBCOMMITTEE XIX ON SHEET STEEL AND STEEL SHEETS

J. M. Watson

COMMITTEE A3 ON CAST IRON AND SUBCOMMITTEE XVIII ON AUTOMOTIVE CASTINGS

F. E. McCleary

COMMITTEE A7 ON MALLEABLE CASTINGS

H. T. Chandler

COMMITTEE B2 ON NON-FERROUS METALS & ALLOYS

*H. C. Jennison

COMMITTEE B6 ON DIE-CAST METALS AND ALLOYS

D. L. Colwell

COMMITTEE B7 ON LIGHT METALS AND ALLOYS

P. V. Faragher

COMMITTEE D2 ON PETROLEUM PRODUCTS & LUBRICANTS

H. C. Mougey

COMMITTEE D11 ON RUBBER PRODUCTS

F. W. Sampson

SUBCOMMITTEE XI ON CHEMICAL ANALYSIS OF RUBBER PRODUCTS

F. W. Sampson

SUBCOMMITTEE XVII ON RUBBER PRODUCTS FOR ABSORBING VIBRATION

F. W. Sampson

COMMITTEE E1-SECTION ON TENSION TESTING

*J. B. Johnson

AMERICAN STANDARDS ASSOCIATION

STANDARDS COUNCIL

C. W. Spicer — M. C. Horine (Alternate)

COMMITTEE ON FORM AND ARRANGEMENT OF SPECIFICATIONS

R. S. Burnett

MECHANICAL STANDARDS COMMITTEE

C. W. Spicer — A. M. Wolf (Alternate)

AMERICAN SOCIETY OF SAFETY ENGINEERS

J. W. Lord

AMERICAN TRANSIT ASSOCIATION

Motor Bus Division

DEVELOPMENT OF BUS EQUIPMENT COMMITTEE

C. O. Guernsey — A. J. Scaife

MAINTENANCE OF BUS EQUIPMENT COMMITTEE

H. L. Debbink — M. C. Horine

ARMY AND NAVY JOINT STANDARDS CONFERENCES

J. F. Hardecker

AUTOMOTIVE EDUCATIONAL COMMISSION

ADVISORY BOARD ON INDUSTRIAL EDUCATION OF BOARD OF EDUCATION, NEW YORK CITY

AUTOMOTIVE UPKEEP STANDARDS COMMITTEE

W. J. Davidson

ENGINEERING FOUNDATION

IRON ALLOYS RESEARCH COMMITTEE

T. J. Wickenden

FEDERAL SPECIFICATIONS BOARD

COMMITTEE ON STORAGE BATTERIES

L. E. Lighton

GUGGENHEIM MEDAL BOARD OF JUDGES

C. H. Chatfield — T. N. Joyce — E. S. Land

JOINT A.S.M., A.S.T.M., AND S.A.E. COMMITTEE ON DEFINITIONS OF HEAT TREATMENT TERMS

*A. L. Boegehold — E. F. Davis — G. L. Norris

MOTOR-VEHICLE CONFERENCE COMMITTEE

F. K. Glynn

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

POWERPLANT SUBCOMMITTEE

Arthur Nutt

NATIONAL RESEARCH COUNCIL

HIGHWAY RESEARCH BOARD

B. B. Bachman — T. C. Smith

ENGINEERING AND INDUSTRIAL DIVISION

Carl Breer — E. P. Warner

NATIONAL SAFETY COUNCIL

GREATER NEW YORK SAFETY CONFERENCE

David Beecroft

RADIO MANUFACTURERS ASSOCIATION

COMMITTEE FOR REDUCTION OF RADIO INTERFERENCE

*L. L. Beltz — *J. H. Little
J. T. Fitzsimmons — L. H. Middleton
P. J. Kent — *T. E. Wagar

Applications Received

(Continued from page 25)

HERTZ, HOWARD D., superintendent of production, Refining Industries, Inc., Portland, Ore.

HILLERY, JACK JAMES, charge automotive maintenance, University of California at Los Angeles, Los Angeles, Calif.

HORI, YASUO, representative, Mitsubishi Jukogo Kaisha, Ltd., Marundushi, Kojimachi-ku, Tokyo, Japan.

JORDAN, ALBERT P., service manager, Autocar Sales & Service Co., Inc., New Haven, Conn.

KENNEDY, LELAND J., engineer, Aviation Mfg. Corp., Williamsport, Pa.

KERR, A. B., publisher, Motor Truck & Equipment, Toronto, Ont., Canada.

KIMBER, CECIL, managing director, The M G Car Co., Ltd., Abingdon, Berks, England.

KINCAID, FRANK M., JR., draftsman, Waukesha Motor Co., Waukesha, Wis.

LEMAY, JOSEPH ARTHUR, superintendent of equipment, Department of Roads, Quebec, Que., Canada.

LITHGOW, JAMES, president, Lithgow Corp., Chicago, Ill.

LOMASNEY, EDMOND P., chemist, Red River Refining Co., Chicago, Ill.

LUNDE, RALPH N., assistant professor, Oregon State College, Corvallis, Oregon.

LYMAN, K. E., technical assistant to the president, Borg Warner Corp., Chicago, Ill.

MAYO, WILLIAM JAMES, examiner, Chief Inspector of Armaments, Royal Arsenal, Woolwich, England.

MAY, WILLIAM ARTHUR HENRY, manager of S. Paulo Branch, Thornycroft do Brazil S.A., Rio de Janeiro, Brazil, S.A.

MEZEY, JOHN B., president, John B. Mezey, Inc., New York City.

MILLER, JOHN HUMPHREY, Aviation Sales Engineer, 32 Grosvenor St., W. 1, London, England.

NAGELY, JOHN L., draftsman, Timken Roller Bearing Co., Diesel Engineering Dept., Canton, Ohio.

NOON, JOSEPH E., service manager, Commonwealth Chevrolet Co., Boston, Mass.

PAGE, FREDERICK HANDLEY, managing director, Handley Page, Ltd., Cricklewood, London, England.

PIAGGIO, ENRICO, F. M. Director, Soc. An. Piaggio & Co., Genoa, Italy.

RAY, JOHN CLIFFORD, assistant superintendent maintenance, Eastern Air Lines, Miami, Fla.

ROMAN, ALFRED I., 835 Riverside Drive, New York City.

RONAN, JOHN T., engineer, Shell Oil Co., Martinez, Calif.

ROSEN, CARL G. A., engineer in charge Diesel development, Caterpillar Tractor Co., San Leandro, Calif.

ROTH, ADAM GEORGE, design and production engineer, Air Associates, Inc., Garden City, L. I., N. Y.

ROWLAND, WILLIAM ALEXANDER, works manager, The Steel Co. of Canada, Ltd., Toronto, Ont., Canada.

SMOOTS, JOHN P., development engineer, Standard Oil Co., Cleveland, Ohio.

SNYDER, RAYMOND R., chief experimental engineer, Pierce-Arrow Motor Co., Buffalo, N. Y.

SONOBE, TSUKASA, representative, Mitsubishi Jukogyo Kaisha, Ltd., Marunouchi, Kojimachi-ku, Tokyo, Japan.

STEINER, EDWARD C., mechanical engineer, Bridgeport Pattern & Model Works, Bridgeport, Conn.

STIENSTRA, AUKE, junior engineer, American Bridge Co., Minneapolis, Minn.

STRICK, ANTHONY DAVID COURTENAY, assistant engineer, Birmingham & Midland Omnibus Co., Ltd., Bearwood, Birmingham, England.

TAYLOR, J. EDWARD, engineering assistant, Gulf Research & Development Co., Pittsburgh, Pa.

TWINING, FREDERICK WOLVERTON, manager and technician in charge of motor laboratory, The Twining Laboratories, Fresno, Calif.

WALKER, GEORGE H., district maintenance engineer, Fort Brady CCC District, Sault Ste. Marie, Mich.

WANER, JACK, treasurer, assistant sales engineer, Transportation Equipment & Service Corp., Chicago, Ill.

WANER, M. C., president, Transportation Equipment & Service Corp., Chicago, Ill.

WOLCOTT, C. FREDERICK, in charge Radio engineering, Noblitt-Sparks Industries, Inc., Columbus, Ind.

WONG, HENRY T., consulting engineer, High Light Trading Co., Tsingtau, China.

Reports of Committees

Meetings Committee Report

THE following meetings, National and Regional, exclusive of regular Section meetings, comprise the meetings program of the Society for the 1936 administrative year, the period extending from the close of the 1936 Annual Meeting to the close of the 1937 Annual Meeting.

Meeting	Place	Date	No. of Sessions	No. of Papers	Attendance
Tractor	Milwaukee	April 15-16	4	6	450
Production	Detroit	April 21-24	8	13	500
Summer	White Sulphur Springs	May 31-June 5	17	36	624
Regional	Dallas, Tex.	Oct. 8-9	5	6	75
Aircraft Production	Los Angeles	Oct. 15-17	7	14	700
Transportation*	Newark, N. J.	Nov. 4-5	2	4	400
Annual Dinner	New York City	Nov. 12	1	1	1069
Transportation*	Los Angeles	Nov. 20-21	5	10	500
Annual	Detroit	Jan. 11-15	19	40	

* Regional

Both National and Regional meetings have profited by the energetic work of the Activities and Sections, the latter in connection with the Regional meetings held mainly under the auspices of the Sections.

General arrangements for the Annual Meeting and the Summer Meeting were in charge of the Meetings Committee, and the technical programs were handled mainly by the Professional Activities. Technical meetings other than the Annual and Summer Meetings were managed by the respective Professional Activities sponsoring them. The Meetings Committee had general supervision of all arrangements for the Annual Dinner, with the assistance of a special Dinner Committee to take care of the details.

The Engineering Display held in connection with the International Automotive Engineering Congress in 1933 and the Annual Meeting in succeeding years was repeated at the 1937 Annual Meeting. Thus various companies were again given the opportunity to exhibit their products and to furnish interesting technical information to the engineers in attendance at the Annual Meeting.

The Ring-Sticking Symposium and the Tourist-Trailer Session at the Annual Meeting were held directly under the auspices of the Meetings Committee. The papers at the former represented contributions from four Professional Activities. The program for the latter was arranged solely through Meetings Committee cooperation.

As in past years, splendid cooperation was received from the Sections in connection with general meetings held in their respective territories, and the Meetings Committee takes this opportunity to thank the Detroit, Metropolitan, Milwaukee, Northern California, Oregon, Northwest and Southern California Sections for their assistance.

The Meetings Committee has taken steps this year to enlist the further cooperation of the Activity Committees in preparing programs enough in advance of the meetings to assure a well-balanced, punctually prepared program.

—H. W. Alden, *Chairman*

Publication Committee Report

WITH the cooperation of special committees of volunteer readers representing each of the activities of the Society, the Publication Committee during the past year has maintained a high quality in the papers selected for printing definitely chosen by these committees of experts as worthy of publication.

During the calendar year of 1936, 910 pages of text and 596 pages of revenue advertising were published in the Journal. Of the text pages, 563 or approximately 62 per cent consisted of papers and discussion; 516 of these pages were published in the Transactions Section. During the preceding year, 1935, 864 pages of text were published, of which 539 or 62 per cent consisted of papers and discussions. The increased number and scope of the regional and general meetings of the Society in 1936, as compared to 1935, the proceedings of which were fully covered in the Journal, accounts for the larger proportion of pages devoted to other than formal papers and discussions. In 1935, there were published 566 pages of revenue advertising.

Sixty-three complete papers, some with discussion, and one discussion printed separately, were published during the year 1936. In addition, there were published five special articles, all of which dealt with technical problems.

In addition, 25½ pages of the Journal were devoted to printing for purposes of record, brief abstracts of all papers presented at the various general and Section meetings of the Society. This practice was begun immediately following the 1934 Semi-Annual Meeting and is being continued as a regular part of the Journal program. Fifteen pages more were devoted to digests in similar form of the oral discussion at the 1936 Annual Meeting.

Transactions

Transactions of the Society were brought up to date by publication about the end of February of Volume 30 covering the year 1935. In this volume there were 487 pages. It contained 56 complete papers and discussions and six discussions printed separately.

Volume 30 was sold to members for $2, the charge being entered upon the bill for annual dues.

Roster

The SAE Roster for 1936 contained the same number of pages as the 1935 edition, names of members on our Reserve Membership List having been omitted.

The Roster for 1937 will be issued with a new cover design about the middle of February and the contents will be similar in all respects to last year's book.

—John H. Hunt, *Chairman*

Membership Committee Report

DURING the past year the activity of the Membership Committee has been rewarded by having the total active membership pass the 5000 mark with an encouraging increase of 370 (excluding enrolled students) over 1935 as evidenced by the following membership statistics:

	1936 (as of Dec. 31)	1935 (as of Dec. 31)
Members	2,779	2,622
Associates	1,337	1,208
Juniors	355	328
Foreign Members	377	346
Service Members	90	71
Departmental Members	3	2
Affiliate Members	71	67
Additional Affiliate Member Representatives	31	29
	5,043	4,673
Enrolled Students	304	218
	5,347	4,891

The increase in the number of applications received for the 1936 calendar year is the result of the activity and cooperation of the National and Section Membership Committees. Comparative figures are submitted below:

Number of applications received as of Dec. 31, 1936 – 701
Enrolled Students – 278
Number of applications received as of Dec. 31, 1935 – 622
Enrolled Students – 231

Sincere appreciation is extended to the members of the Sections who have worked so diligently throughout the year.

—George O. Pooley, *Chairman*

Research Committee Report

THIS is the first annual report to appear bearing the new designations for the General Research Committee and its committees. Early last year the Society's Council upon recommendation of the Research Committee changed the name of that Committee to "General Research Committee", and designated as "committees" the research groups then known as "subcommittees". This change in no way affected the functions of these committees.

Crankcase Oil Oiliness

Seventeen laboratories are cooperating in the Crankcase Oil Oiliness Research Committee's program of engine tests to determine whether or not it is possible to show an advantage in the use of oiliness agents as an addition to mineral oil under engine operating conditions. In addition six laboratories are participating in a special phase of the program involving long-period wear tests in C.F.R. knock testing engines. The tests are being conducted on two test oils prepared under the direction of the Committee: a mineral oil and the same oil compoundd with sperm oil.

A progress report covering data received up to the time of the Annual Meeting is being prepared by the subcommittee appointed to analyze the test data.

A special subcommittee delegated to receive suggestions and formulate a definition of the term "oiliness" has under way the preparation

of a proposal for consideration by the Committee as a whole.

Crankcase Oil Stability

Data from sixteen participating laboratories giving results of ring-sticking tests by individual methods on the Crankcase Oil Stability Research Committee's three coded test samples were analyzed and a summary report issued to the Committee. The three oils included one known to be a ring-sticking oil, a non-ring-sticking oil and one which was not definitely in either of those two classes.

From the results of these tests the Committee concluded that effects of a wide range of operating conditions were of considerably greater importance in the rating of these particular test oils than the actual differences between the oils.

The Committee has instituted a periodic circulation of oil samples for cooperative tests and the draft of a tentative program of future work and proposed uniform method for recording test data are before the Committee for definite action.

Extreme-Pressure Lubricants

The series of cooperative tests conducted on the first production lot of 21 Extreme-Pressure Lubricants Testing Machines, employing seven of the original ten types of lubricants tested by the National Bureau of Standards, has been completed by all participants. Summary data sheets covering results of these tests were prepared and presented to the Committee in June, 1936, by a special subcommittee for correlating test program data and on the basis of this report the Extreme-Pressure Lubricants Research Committee took action approving the principle of design and operation incorporated in the machine and authorized the production by the Highway Trailer Co. of additional machines upon receipt of orders subject to the approval of the Extreme-Pressure Lubricants Executive Committee. Ten machines have been produced in a second production lot and recently delivered to the purchasers all of whom have agreed to cooperate with the Committee by contributing to the further development of the machine and methods of test. Authority has been given for the building of additional machines, should the demand be established by firm orders.

A report is expected shortly from a subcommittee instructed to prepare an outline program of future work on measurement of Extreme-Pressure Lubricant characteristics other than load-carrying capacity.

Front-Wheel Alignment

Wheel-Alignment specifications for 1936 passenger cars, trucks and buses, collected, compiled and tabulated by the Front-Wheel Alignment Research Committee were published in the October, 1936, issue of the JOURNAL.

The Committee has continued its cooperation with the Highways Research Committee in formulating the wheel-alignment phase of the recommended procedure for motor-vehicle inspection and considerable time has been spent in developing a recommended procedure for inspection of the steering mechanism.

Highways Research

The Highways Research Committee in cooperation with other SAE Committees has continued its work toward developing Recommended Practices for Motor-Vehicle Inspection with a view to providing a technical basis for limits and test methods for the use of enforcement officials in states and municipalities that have instituted compulsory motor-vehicle inspection.

The Committee has also cooperated with the Bureau of Motor Carriers of the Interstate Commerce Commission, and the American Standards Association, providing the technical data necessary in formulating regulations in promotion of highway safety.

Ignition

Early in the year a questionnaire was circulated to passenger car, truck and tractor manufacturers, automobile, aircraft and marine-engine builders, and a select group of operators, as to the desirability of undertaking certain specific studies in connection with spark plugs and other closely related ignition problems, and requesting suggestions for other desirable items of future program. Replies to the questionnaire were overwhelmingly in favor of the proposals and included a number of further comments and suggestions. Accordingly the Ignition Research Committee authorized the collection and study of available methods of test for high tension ignition cable and delegated a subcommittee to make preliminary tests with a view toward developing a tentative program of spark plug tests employing the C.F.R. Engine.

Riding Comfort

Of the riding-comfort measuring instruments previously described in Riding-Comfort Research Committee reports those developed by Purdue University and the Chrysler Corp. have during the past year become commercially available; the instrument developed at the Firestone Tire and Rubber Co. is now under intensive development and it is expected that both the Firestone integrating accelerometer and the National Bureau of Standards Ridemeter will be available shortly.

An article descriptive of these instruments entitled: "Practical Measurement of Riding Comfort" was sponsored by the Committee and published in the August, 1936, issue of the JOURNAL. Supplementary articles by H. C. Dickinson, R. W. Brown and C. A. Tea appeared under the title, "Symposium on Measurement of Riding Comfort", in the October issue of *Instruments*.

A paper on "Human Reactions to Vibration" was presented at the Society's Summer Meeting by Prof. H. M. Jacklin and published in the October, 1936, issue of the JOURNAL.

The Committee is completing arrangements with manufacturers for the circulation of available riding-comfort measuring instruments to interested laboratories for correlation tests.

In response to a request for data on the question of the relationship between vehicle speed and road curvature as affecting riding comfort, the Committee collected considerable data.

A special subcommittee is developing a tentative program for investigating the importance of seat cushions in their effect on riding comfort.

Textile Research

The need for controlling shade variations in automobile trim cloth was brought before the Research Committee at its January, 1936 meeting. As an outgrowth of the informal activities of a special committee delegated to investigate the need for research on this subject, a joint meeting of representatives of the automotive industry, represented through the Society, and members of the Textile Foundation and National Association of Wool Manufacturers was held in September of this year and resulted in the formation of a working group representing the various interests. A tentative program of activity, budget of expense and proposed method of financing a research on means for securing more uniform shades in automobile trim cloth have been prepared for consideration by the interested groups.

Cooperative Fuel Research

The research program for full-scale detonation work with aviation fuels above 87 octane number, developed by the Aviation Gasoline Detonation Subcommittee early in the year, is in progress. A sub-subcommittee has been organized to coordinate the activities of the laboratories interested in the investigation and possible development of laboratory practices yielding results in correlation with full-scale data as provided for through the cooperating aircraft engine laboratories, and the committee has developed specifications and established sources of supply for reference fuels suitable for use in this octane bracket, and prepared a proposed list of test fuels.

The name of the Aviation Gasoline Detonation Subcommittee, by action of the Cooperative Fuel Research Committee at its last meeting, has been changed to "Aviation Fuels Subcommittee" and the newly named committee has been delegated to carry on the existing work of the Aviation Gasoline Detonation Sub-committee and undertake a fuel line temperature and vapor lock survey of aircraft installations.

The Committee made a request to automotive manufacturers to participate in and submit results from cooperative tests on the vapor lock and octane requirement of various models of 1936 and 1937 passenger cars, trucks and buses. For this purpose the Committee developed and approved for tentative use proposed methods for obtaining the octane requirements of cars on the road and for vapor lock testing procedure. The data resulting from this C.F.R. Motor Survey have been combined with those obtained through the American Petroleum Institute Automotive Survey and an analysis prepared. A study of these data have indicated need for improvement in the testing technique and modification of the test methods and test conditions making them applicable to heavy duty vehicles. The committee has arranged to continue its cooperation with the A.P.I. Automotive Survey Committee; to further develop the methods of test; and to seek further cooperation from a greater number of automotive manufacturers. Provision has been made for analysis by the National Bureau of Standards of data obtained in these surveys.

The first "Cooperative Fuel Research Motor Gasoline Survey, Winter 1935-36," resulting from the cooperative agreement whereby the National Bureau of Mines completed the analysis of data collected by the Committee in a national gasoline survey, was issued in mimeographed form by the Bureau. The second of these reports covering samples gathered during the summer of 1936 will shortly be available.

The C.F.R. Committee authorized the publication in the October, 1936, issue of the JOURNAL of an article entitled: "The Precision of Knock Rating," an analysis based on comparison of results obtained in laboratories using C.F.R. test procedure and those obtained in actual car operation at Uniontown.

A plan to provide for participation twice each year in the Cooperative Exchange knock rating tests by non-members of the Group who may desire to check their results on the C.F.R. Engine with the average of results obtained by the members of the Group has been in operation during the past year; fifty-two non-member laboratories cooperated in the last series of these tests. Upon demand participation in these tests has been opened to companies in foreign countries provided they designate a United States agency to act for them in transacting the business details in connection with the purchase and shipment abroad of the test fuel samples.

The Waukesha Motor Co. has developed a modification of the C.F.R. knock testing engine permitting high speed operation.

The Subcommittee has continued its study of factors affecting knock rating and as an outcome of these activities three progress reports on the effects of altitude, humidity, and knock intensity were approved for presentation at the Society's Annual Meeting, 1937.

As a result of discussion precipitated by receipt of a report: "Correlation of Laboratory Knock Testing Engine Ratings with Knocking

in Automobiles" contributed by a member laboratory, the Detonation Subcommittee at its last meeting, with approval of the C.F.R. Committee, took action toward planning cooperative road knock ratings, and recommended that road ratings of current automobiles be reviewed and a flexible laboratory method for rating fuels established.

Under the direction of a Program and Executive Committee a reorganization of the sub-subcommittees has been effected and the recently appointed Sub-subcommittee to Analyze Car Correlation Data has prepared for consideration by the Detonation Subcommittee a comprehensive report covering data from fifteen independent sources and involving over two thousand separate road ratings on 1934, 1935 and 1936 model cars. A sub-subcommittee delegated to develop suitable laboratory procedures has developed a program and work is in progress.

During the year the Detonation Subcommittee delegated a special sub-subcommittee to study the rating of motor fuels in the octane bracket over 80 and to consider the question of secondary reference fuels suitable for use in that range.

—G. W. LEWIS, *Chairman*

Sections Committee Report

THE calendar year 1936 has been one of outstanding progress for the 22 Sections of the Society. At 167 meetings (an increase of seven over the same period last year) the total attendance approximately was 25,000 as compared with 23,000 for 1935. The meetings were well planned and designed to bring before the membership of each Section new developments and advancements of greatest interest. The increased attendance at these Section meetings is evidence of the appreciation of the membership for the fine programs worked out by the Section officers.

A breakdown of the number of papers presented on the various subjects discussed is given below:

Aeronautics	31
Bodies	9
Diesel Engines	21
Engines	9
Fuels and Lubricants	14
General	30
Marine	3
Materials	4
Parts and Equipment	11
Passenger Cars	13
Plastics	2
Production	8
Racing Cars	4
Research	2
Regulation and Legislation	2
Rubber Products	2
Student Papers	5
Traffic and Safety	15
Transportation and Maintenance	17
Truck, Bus and Railcar	7

In addition to the above presentations there were

7 outings
13 inspection trips
5 social meetings

The general topics included such subjects as acoustics, automotive engineering in the world, keeping the industry young, photo-elastic studies, etc.

Regional Meetings

Fourteen regional meetings were held in localities other than the Section cities, thus giving members in these outlying territories opportunity to participate in SAE activities. In addition to its regular meetings in Toronto, the Canadian Section held meetings in Hamilton, Windsor, Oshawa and Montreal, and has appointed additional vice-chairmen covering these localities to represent them on the Governing Board of the Section. The Metropolitan Section held a Regional Transportation and Maintenance Meeting in Newark, N. J., in which the Southern New England and Philadelphia Sections participated. Cleveland Section held a regional meeting in Akron, Philadelphia Section in Camden and Bethlehem, Pittsburgh Section in Hamarville, Indiana Section in Anderson, Milwaukee Section in Oshkosh and Southern New England Section in Bristol.

Committee Appointments

Early appointment of Committee Chairmen and Committees was the rule in 1936. The close of the calendar year showed every Section with complete Committee set-up and each Committee working actively toward the general progress of the Section.

Membership Work in the Sections

Practically every Section has experienced a decided increase in its membership, due in great measure to the activity and initiative of the Section Membership Committee. In choosing his Committee, each membership chairman gave particular thought to the qualifications of the men selected for his Committee, and outlined definite objectives. George O. Pooley, Membership Committee Chairman of the Society, worked in close contact with the Section membership men and established a system of pictorial charts indicating the gains of the Sections each month. In nearly every instance, monthly Membership Committee meetings were held, and all signs point to a banner year ahead in membership increase accomplishments.

Section Meetings

Because of the large percentage of guests at Section meetings in comparison with the number of members in attendance, as brought out in a survey made a short time ago, an innovation in the way of closed meetings was tried out this year by two Sections. The Oregon Section held two such meetings and voted unanimously to continue the policy, holding three or four of these meetings throughout the administrative year limiting the attendance to members only. The Detroit Section held one closed meeting with very satisfactory results.

The decision of the Detroit Section to hold each Activity responsible for a certain number of meetings per year has worked out very well, insuring a diversified program of meetings and a more complete coverage of the interests of the membership. The participation of the four Coast Sections in the National Aircraft Production Meeting in Los Angeles has spurred SAE aeronautic interest on the Pacific Coast, and the Southern California Section has done commendable work in this regard.

Placement Work in the Sections

In December, 1935 the number of totally unemployed members on the list of the Placement Department was 132. As of December, 1936 this figure has been decreased by two-thirds, showing a marked reduction in unemployment among SAE members. Section assistance in this reduction was of primary importance, 17 Sections having appointed Placement Chairmen to carry on the work locally and to cooperate with the Placement Department at Headquarters. In some Sections there is no unemployment among the members at the present time.

Student Activities

One of the outstanding features of the past year was the pronounced interest in student enrollment in the SAE on the part of engineering students all over the country. SAE Student Branches have increased to eight in number, the latest additions being Purdue University and the University of Alabama.

Regular meetings are being held by the Student Branches, and in some instances joint meetings of the Sections and the students have been scheduled. The Indiana Section joined with the Purdue Student Branch in an inaugural meeting at West Lafayette, which was addressed by President Teetor, and at this meeting the charter for the Branch was presented formally to the University and the students. The Detroit Section is continuing its policy of holding Junior and Student Meetings as a regular part of its Section program, and Cleveland, Metropolitan and Oregon Sections are scheduling prizes for the best student papers presented during the administrative year.

The Student Chairmen appointed by 15 Sections have worked very effectively with their Sections and Headquarters in the interest of the students.

SAE Clubs

The SAE Club of Denver and the SAE Club of Wichita are carrying on satisfactorily in their localities. The Denver Club has staged some fine meetings with exceptional attendance, and is planning a schedule of real interest to SAE members in the territory.

The year 1936 was one of progress and accomplishment among the Sections, and much credit is due to the splendid activity of the Section officers coupled with the cooperation of the Section membership.

—FREDERICK K. GLYNN, *Chairman*

Standards Committee Report

THE following is a brief resume of the principal activities under the Standards Committee during the administrative year just closing:

Division Reports

There are 20 Divisions of the General Standards Committee. During the year five Divisions reported 12 subjects at the SAE Summer Meeting in June and 11 Divisions reported 38 subjects at the Annual Meeting in January, 1937. Three of these Divisions reported at both meetings, thus making a total of 13 individual Divisions reporting a total of 50 subjects during the administrative year. Although many of these reports were in the nature of revisions, they affected some of the more important standards published in the HANDBOOK and will bring it more nearly up to date as a complete volume of the Society's specifications.

Among the new specifications adopted are insert valve seats for engines, the tractor magneto flange mounting, emergency lanterns for motor trucks, a clearance, marker and identification lamp specification and a code for the inspection of headlamps in use. Additional tables of special screw thread size and pitch combination have been prepared and a new testing code for agricultural and industrial tractors completed. Among the most important of the standards affected by these actions are those for aircraft parts, aircraft-engine shaft ends, the specifications for automobile lighting, some of the non-ferrous metals data, a new specification covering glass for motor vehicles and the tractor testing code which it is expected will be of wide value to the tractor industry.

The initiation of standardization work in the touring trailer field during the year is of particular interest and significance in that it has enabled the Society to establish close cooperative contact with a new and rapidly growing industry that is important to the automotive industry. The Society will continue to cooperate in this field.

The Standards Committee's cooperation with similar committees of other Societies such as the American Transit Association, the American

Society for Testing Materials, the Army and Navy Standards Conferences, etc., have continued as usual during the year and reports of such Committees as released are referred to the appropriate Divisions of the Standards Committee.

A considerably increased number of subjects in progress are being carried over to next year, several of which should be completed for adoption by the Society at the next Summer and Annual Meetings.

Sectional Committees

As reported during previous years the Society's activities on Sectional Committees under American Standards Association procedure have continued, both those for which the Society is a sponsor and those on which it is only represented. Sectional Committee reports have been approved during the year, particularly in the field of small tools and machine tool elements.

SAE Handbook

During the recent financial depression HANDBOOK cost was reduced by issuing supplements instead of complete annual HANDBOOKS. The combination of partially obsolete HANDBOOKS with supplements met with much criticism. Beginning with the 1936 edition, the HANDBOOK will again be issued complete annually. This edition carried a new cover design and contained as usual, new data and information relating to the Society's standardization activities. During the year there has been an increased demand for copies of the HANDBOOK, particularly from non-members of the Society, both in the United States and throughout the world. The Iron and Steel, the Non-Ferrous Metals and the complete Screw Thread specifications have, as during the past two or three years been issued also in separate booklet form and there has been a wide distribution of these individual specifications, particularly of the SAE Steels.

General Progress

The pronounced up-turn in the automotive and associated industries, particularly during the later months of the year has resulted in a very much quickened activity of the Divisions of the General Standards Committee and it is probable that during the next year or so these activities and the many new engineering designs and practices will lead to revision of many of the older SAE specifications, the adoption of many new ones and the cancellation of some that will have become obsolete in practice. It is the purpose of the Standards Committee to keep abreast of these new developments so that as the HANDBOOK is issued each year, it will become an increasingly valuable reference to the designing and specifications engineer, the production department, the purchasing agent, the user and to administrative officials of the State and Federal Governments. It is interesting to also note in this report that evidence has been received that these SAE Standards are being used more widely than ever by many non-automotive industries, indicating a growing appreciation of the value of standards that are established on reliable experience.

The General Standards Committee hopes that with the pronounced revival in the industry, the executives, engineers and production men in the industries will keep these activities of the Society in mind and that they will continue to cooperate fully in keeping the data in the SAE HANDBOOK thoroughly up to date and of greatest value. As all of these standards are valuable only to the extent they reflect the soundest experience in industry, the activities of the Standards Committee must have the continued support and cooperation of the industries themselves.

—C. W. SPICER, *Chairman*

Treasurer's Report

OUR Society ended the fiscal year Sept. 30, 1936, with an unexpended income for the year of $12,806.41. This compares with $13,281.00 for the previous fiscal year. The budget had provided for a net unexpended income of $2,155.00 so that our Society's financial position is $10,651.41 ahead of the mark set in the budget.

This improved condition is due to an excess of 4 per cent income above the budget figure, but the expenses were $222,872.81, or $1,972.19 under the budgeted figure.

Those departments in which actual expense exceeded the budgeted figures were publications, sections, hand book advertising, JOURNAL advertising and miscellaneous sales. Some departments that were under budget marks were research, standards, regional meetings, meetings and membership increase.

The year's income increased 4 per cent over the budget estimates and 8 per cent over the previous year's income. Operating expenses showed an increase of 8 per cent over the expenses of the previous year.

Those sources of income that exceeded budget estimates were dues and subscription, initiation fees, affiliated appropriations, miscellaneous sales, and interest and discount. JOURNAL advertising, the largest individual source of income, showed a 7 per cent increase over the previous fiscal year and almost exactly equalled the budgeted estimate.

The expenses of the Society for the fiscal year ending Sept. 30, 1936, increased 9 per cent over that of the previous year. The budget provided for a total expenditure of $224,845.00,

The investment portfolio of the Society was increased by $31,796.26 during the fiscal period, its total book value on Sept. 30, 1936, being $184,856.51. The actual market value of these securities on that same date was $203,588.12.

The comparative balance sheet and income and expense statements as of Sept. 30, 1936, which are a part of this report, show in detail the status of the Society's finances as of that date. —DAVID BEECROFT, *Treasurer*

BALANCE SHEET AS OF SEPTEMBER 30, 1936

Assets	
Cash	$ 28,828.53
Accounts Receivable	4,336.99
Securities	*184,856.51
Accrued Interest on Securities	2,524.38
Inventories	794.70
Furniture and Fixtures	1,000.00
Items Paid in Advance, Charges Deferred	7,195.90
TOTAL ASSETS	$229,537.01
Liabilities and Reserves	
Accounts Payable	$ 100.50
Dues and Miscellaneous Items Received in Advance	7,284.09
Reserve Set Aside for Anticipated Expense	11,182.47
General Reserve	198,163.54
Net Unexpended Income	12,806.41
TOTAL LIABILITIES AND RESERVES	$229,537.01

*** Book Value (Market Value Sept. 30, 1936 – $203,588.12).**

INCOME AND EXPENSE AND BUDGET COMPARISON
TWELVE MONTHS, ENDING SEPT. 30, 1936

Income	Oct. 1, 1935 to Sept. 30, 1936	Budget
Dues and Subscriptions	$ 72,216.98	$ 70,000.00
Initiation Fees	10,808.50	10,000.00
Interest and Discount	7,212.34	7,000.00
Affiliated Appropriations	7,500.00	5,000.00
Advertising – Journal	109,679.00	110,000.00
Advertising – Handbook	6,125.00	6,000.00
Miscellaneous Sales	21,606.22	19,000.00
Unused Portion of Section Dues	555.00	....
TOTAL INCOME	$235,703.04	$227,000.00
Expenses		
Research	$ 15,177.41	$ 15,680.00
Standards	7,415.14	7,970.00
Publications	45,085.07	44,340.00
Sections	10,438.28	7,800.00
Regional Meetings	1,161.04	1,700.00
Meetings	14,897.54	15,620.00
Institutional Promotion	2,163.94	4,020.00
Professional Activities	272.82	200.00
Membership Increase	10,470.63	12,100.00
Advertising – Journal	31,233.10	30,830.00
Advertising – Handbook	1,352.38	1,150.00
Miscellaneous Sales	8,030.09	7,420.00
General Expense	75,175.37	76,015.00
TOTAL EXPENSE	$222,872.81	$224,845.00
Loss from Sale of Securities	23.82	....
Net Unexpended Income	12,806.41	2,155.00

1937 Annual Meeting

(Continued from page 20)

equipment – perfectly safe and satisfactory in use while the trailer is still – would have to be redesigned to give safety and satisfaction if used when in motion. He pointed to the fact that in Great Britain, where trailer experience is older, the law forbids occupation while in transit. Norman G. Shidle, editor, SAE JOURNAL, felt that decision as to whether or not people are to ride in moving trailers is fundamental to any study of probable design trends in this industry. J. G. Morrow, of the Steel Co. of Canada, contended that, if trailer riding is comfortable, it will be practiced.

A. G. Herreshoff, Chrysler Corp., who presided at the session, pointed out that the trailer design partakes of the automobile, house and boat and spoke a favorable word for the strength and use possibilities of wood in trailer body construction. His feeling is that few people do ride in moving trailers and that, therefore, the trailer safety problem is primarily one concerning other users of the highway – and of proper balance in the steering of the tow car.

L. K. Snell asserted that every trailer should have brakes and emphasized the need for working out a practical means of making trailer wheels follow directly in the tracks of the tow car. Trailers today do not track the car closely, Mr. Snell contended, despite statements to the contrary.

Harry T. Woolson, Chrysler Corp., said that the automobile industry almost certainly would be glad to build chassis especially designed for hauling trailer coaches provided sufficient demand developed to make sales profitable.

Are Trailers Undertired?

Mr. Smith's suggestion that the average trailer is undertired was supported by a representative of the tire industry, who expressed the belief that customers will expect the same tire service on trailers as they get on their cars. Some trailers are even undertired when they leave the factory, he contended, making a plea for more adequate provisions in this regard. W. Russel Wilday pointed out that the trailer actually has helped the hotel business by virtue of stimulating people to move from place to place; that it has helped rather than hurt real estate and that trailer makers have gleaned much useful information from studies made by the Insurance Underwriters Laboratories.

Mr. Scheff said that practically all trailer makers believe in universal brake equipment, but plead that the public could not always be made to pay extra for such equipment even when strongly recommended by the manufacturer.

The trailer industry, he thinks, will never equal the automobile business, but will eventually go ahead of boat building. Trailer design, he said, tries to give the most in comfort and convenience in interior layout. "Styling and streamlining," he said, "have been tried to the complete sorrow of the designer, particularly if he were the manufacturer as well." Mr. Scheff belittled the claims of those who see steel as essential to trailer body construction stating that "steel coaches have been made since 1932, but no company has been successful in building up production or volume sales with a metal coach. The exponents of the composition body, however, all make the mental reservation," Mr. Scheff added, "that if, and when, the public demands the steel coach in preference to all else, they are ready to supply it."

"The design of a light metal steel body would be a simple matter of routine design," G. W. Smith, Palace Travel Coach Co., stated in his discussion which touched on various trends in trailer design. "The real difficulty," he said, "would begin when the designer had passed the job along to the production organization and the management was informed as to the cost of fabricating equipment. A rough guess would place the required production at 20,000 to 50,000 units a year as a minimum."

Automobiles and Trailers Are "Shelter"

Urging that trailers, automobiles and houses all be thought of as different kinds of shelter and their possible development studied in the light of that approach, Corwin Williams of Flint, said that "as yet, mobile shelter is dominated by the techniques evolved during the past two decades for building truck and motor car bodies." This process will probably be changed in the future, he thinks. "The motor car in America," he added, "already our most popular form of shelter, is in its babyhood. The sweep of its further development, stimulated by this irresistible stampede to buy travel coaches, and by this universal American need for a cheaper and better form of mass shelter, will be swift and incredible."

Written discussion submitted by Ray F. Kuns, Trotwood Trailers, Inc., who was unable to be present, brought out various aspects of the idea that probably "more worthwhile engineering facts will find expression in a convention of trailer owners than will be heard in a convention of engineers just becoming trailer conscious."

Automotive engineers, Mr. Kuns believes, can contribute definitely in the fields of safety, service, life, convenience, health and sanitation. He urged that each car manufacturer turn out one model – called perhaps a trailer sedan – with full provision for trailer coupling, all manufacturers to specialize on one particular type of coupler engineered to give satisfactory car and trailer performance.

Answering a question as to what part the SAE should play in the development of better engineering standards in the trailer field, Mr. Herreshoff told of the joint committee of SAE standards representatives and the Trailer Coach Manufacturers Association already at work on standardization of trailer hitches and of plans for further cooperation on other units in the future.

Unit Chassis-Body Design Praised

THE trend toward frameless body construction was evident in the papers and discussion heard at the Body Symposium Wednesday morning. Edward G. Budd, Edward G. Budd Manufacturing Co., stated in his paper that it seems probable that this new method of body-chassis construction will gain ground. Stanley E. Knauss, motor coach division, Gar Wood Industries, Inc., quoted from his company's practical experience in producing buses with this type of construction to show greater safety, lighter construction, economy in operation and comfort to passengers. Ralph Upson, aeronautical engineer, advocated such construction "be-

cause it is rational and sensible." Howard D. Brown, Detroit Automobile Inter-Insurance Exchange, introduced the relationship of insurance rates to accidents and to body design in his paper, "Modern Body Structure and the Service Problem."

Mr. Budd pointed out that the achievement of the modern all-steel body is not entirely due to the ingenuity of the body engineer – but also to the developments in machines, materials and mechanical practice. Streamlining, a necessity in aircraft design, he said, has become also a compelling force in automobile design. With the development of chassisless construction Mr. Budd believes that the art of flash welding will again play an important part in body construction; sheet steel will be required. With the adoption of this construction he believes engineers will need accurate familiarity with the placement of engines, springs and all related parts. Power equipment, he added, will have to be installed after the unit has been built, finished and trimmed. Mr. Budd thinks that in passenger car construction there will be a very small margin of weight saving and that it will be difficult to add the present cost of a chassis, from $9 to $15, to the cost of the present body and produce a combination of body and chassis. "We will have to do some close figuring," he concluded. (Mr. Budd's paper is printed in full beginning on page 65 of the Transactions Section of this issue.)

Frameless Bus Body Described

Mr. Knauss described the frameless motor coach conceived by William B. Stout and constructed by his company. It was engineered by aircraft men and constructed by a shop personnel who were trained in aircraft factories. Among the details of construction he noted that the materials used in the framework are mostly 1¼ in. square welded tubing and a small amount of round tubing at front and rear ends where double curves appear; all frame joints are welded; outside metal covering for sides, roof and bottom is of 22-gage body steel and installed with self-threading screws. The complete weight of the 24-passenger coach is less than 6500 lb., he said. Because of its light weight, Mr. Knauss pointed out, it is possible to use smaller mass-production powerplants, axles, transmissions, clutches and also smaller tires. Speaking of performance he noted that in the operation of a fleet of these buses tire mileage has averaged in excess of 60,000 miles per set, brake linings have frequently given better than 40,000 miles of service and that gasoline mileage is more than twice that of heavier vehicles of equal seating capacity. He also stated that performance is stepped up nearer to motor car proportions. Using slides he illustrated the safety of these coaches in case of accidents.

Criticizing the present automobile from an aircraft viewpoint, Mr. Upson believes that the basic trouble is failure to secure a balanced design. Taking streamlining as an example he said:

"As the direct object of streamlining is to cause air to close in behind without permanent displacement, there is little to be gained by streamlining the top alone; similarly, streamlining the front is ineffective if the air concerned is to be caught by projections and dead spots further back; and fine lines at the back have no chance to act unless the air can be led smoothly to them."

He listed six specific possibilities for reduction of drag and weight as follows:

1. Improved streamlining of necessary exposed parts, particularly underneath; and incorporation of other accessories in the general body lines.
2. Use of curved glass in the windshield; and lightening of all window material.
3. Reduction of the frame to the status of an assembly unit, with structural significance only in combination with body.
4. More effective distribution of flanged material around the doors.
5. Lightening of skin by use of internal stiffeners, particularly on top.
6. Development of a smaller, more efficient radiator; and lightening of various engine parts.

Modern Body Raises Insurance Cost

If automobiles are designed so that repairs after accidents cost less, insurance rates go down – if they cost more, insurance rates go up, Mr. Brown explained. He also noted that the cost of repairing cars that have been in accidents has increased almost 25 per cent in the past three or four years. Grille work on radiators, fender aprons and knee-action have all increased repair costs, he explained. Body designers and other automotive engineers can help to keep these costs down by so designing the cars that accidents are less costly, he stated, adding that other elements which enter into the cost of repairs include the availability of parts, proper repair equipment and experienced mechanics within reasonable distances of wherever an accident may occur.

Session Chairman R. J. Waterbury, retiring vice-president representing the Passenger-Car Body Engineering activity, introduced the incoming vice-president, L. L. Williams, who presided at a brief business meeting before the discussion was opened.

The first questions were asked by Lee Oldfield who wanted to know if trucks and buses were not better adapted to frameless construction than passenger cars, mentioning that a number of passenger cars are either open models or convertibles. In answer, Mr. Budd agreed that this is the case, and that it will probably be the prevailing method of construction, particularly of buses.

P. M. Heldt stated that open cars can be of frameless construction. He was supported by E. L. Allen of Auburn who pointed out that Cord open models are so constructed. In building them the box-sill structure is twice as strong as in closed models, he said. Another speaker spoke of owning several open cars of foreign make that are of unit construction.

Mr. Waterbury asked Mr. Knauss if the panels of the Gar Wood coach contribute to its strength, have a rumble, and if the accident mentioned in his paper was expensive. Mr. Knauss replied that the panels were not designed to contribute to the strength of the coach, but that they do, perhaps, make it 10 or 15 per cent stronger. Rumble, he said, is lacking due to insulation. The bus is extremely quiet, he added. He pointed out that the accident in question was reasonable enough to repair, particularly as it is almost certain that a bus of conventional design in such an accident would have been a complete wreck, ready for junking.

Hal Holtom, Vaco Products Co., asked about comparative weight and comparative costs of the coach discussed and a coach of conventional construction. The bus described weighs about 6300 lb. and carries 24 passengers as against an average 21-passenger bus weighing 7300 lb., Mr. Knauss replied, adding that it is worth a great deal to an operator to save 1000 lb. The cost of construction in like quantities would probably be a little more, he said.

Mr. Brown, in answer to a question, listed some of the

SAE Engineering Display

Thirty-one companies exhibited their products at the Engineering Display held in conjunction with the 32nd SAE Annual Meeting. Located on the floor where all the technical sessions were held, it was visited by most of the 2500 engineers who gathered in Detroit for this event. The murals in the exhibit room, designed by Fay Leone Faurote (M '11), depicted the story of transportation from the state chariot of Tut-ankh-Amen through the ox-cart and buggy eras, to the present day of streamlined car and train, oceanic dirigible and China Clipper.

more common injuries to car occupants involved in accidents and suggested that the Society could be in a better position to contribute to safe design if an SAE committee were appointed to cooperate with insurance companies in a study of accident records on file to learn what they are and how they happen.

L. L. Williams, A. J. Scaife and others contributed further to the discussion of the relative merits of frameless and conventional construction.

Operators Suggest Truck Design Changes

TRUCK manufacturers attending the opening Transportation and Maintenance Session, Monday morning, learned what operators think of the trucks they operate. The information was given in no uncertain terms because the paper presented, "Vehicle Design from a Maintenance and Operating Point of View," was a report of the T. & M. Subcommittee on Motor-Vehicle Design and Operation, prepared and presented by its chairman, F. L. Faulkner, Armour & Co. This was the fourth time that Mr. Faulkner has represented the T. & M. committee at national SAE meetings.

Complimenting the truck manufacturers upon giving more per dollar than in 1934, general improvement in braking systems and bettering front-axle location and design, Mr. Faulkner deplored that engine sizes have not kept pace with increasing gross vehicle weight, that clutches are still inadequate, that except in the 14,000 to 16,000-lb. G.V.W.-class, there is no improvement in the section modulus of the frame, that there is little change in rear-axle capacities and that the grade ability of late-model 1936 and early-model 1937 trucks falls short of that of 1934 models, except in the 14,000 to 16,000-lb. class. He noted that vehicles in this class are, in general, materially improved.

These observations, Mr. Faulkner reported, are based on studies of specifications made by his committee. "The purpose of these studies," he said, "is to point out inconsistencies that exist in the various weight classes with the hope that a better-balanced vehicle will be produced so that the operator in purchasing a vehicle of a certain rating can be assured of a reasonably uniform performance irrespective of the make of the vehicle." He also explained that the operators are not desirous of designing or building trucks, but "when we are confronted daily with manufacturers' errors that we must live with day in and day out, we feel that we have a right to a hearing on the subject."

In remarking on data on ignition equipment, battery and starter-generator combinations, which were accumulated and supplied by R. M. Critchfield, Delco-Remy Corp., Mr. Faulkner said that in many instances repair expenses on ignition equipment alone, incurred throughout the life of the vehicle, equal the repair expense on the balance of the engine. In general, he continued, coils, condensers and distributors furnished as standard equipment on the light duty jobs are not satisfactory for the work. Mr. Faulkner blames this and other deficiencies on the vehicle manufacturer who is building to meet a price. Batteries, he said, are mounted in out-of-the-way places and in many instances are inadequate, although there has been a marked improvement in battery size and rating since 1934. Starting motors have shown little improvement since 1934, he reported, particularly from the standpoint of eliminating starting difficulties under low-temperature operating conditions. He noted a general improvement of generator characteristics.

Mr. Faulkner read excerpts from a report by Mr. Critchfield which gave his conclusions from an analysis of the survey. Mr. Critchfield also mentioned that Diesel engines present a much more difficult cranking problem than do the conventional gasoline types, requiring larger starting motors. Generators of virtually standard capacities are satisfactory for Diesels, he explained. In view of the energy required to crank engines of this type he noted that batteries of greater capacity are required.

Turning next to the subject of tractor-trailer coupling heights, Mr. Faulkner read a report furnished by M. C. Horine, Mack-International Motor Truck Co. After reviewing the need for standardization of fifth-wheel coupling heights and past SAE efforts to accomplish it, Mr. Horine explained the reasoning which led the committee to make the following proposal for a standard: "Height of underside of

fifth wheel upper half on semi-trailers shall be equal to the height of the tires above the road surface plus 2½ in., measured on the transverse centerline of the kingpin. Height of upper surface of fifth wheel lower half on tractor-trucks shall be equal to the height of the tires above the road surface plus 6½ in., measured on the transverse centerline of the kingpin socket, with turntable parallel with the frame. (Height of tire, as referred to above, shall be the sum of the loaded radius plus one half the total diameter.)"

Truck Brake Applications

The fourth part of Mr. Faulkner's report was on Brake Application with Suggestions for Standardization. This was prepared by Stephen Johnson, Jr., Bendix-Westinghouse Automotive Air Brake Co. Among the recommendations reported are that the weight-area ratio should be 40 lb. of gross vehicle weight per square inch of brake lining area; 150-lb. foot pressure as maximum to operate brakes; 100 lb. as maximum pull to operate auxiliary brake; that an auxiliary brake should hold a vehicle with brakes on all wheels on a 45 per cent grade, and a vehicle with brakes on the two rear wheels of a four-wheel vehicle on a 27 per cent grade. The committee also recommends that any motor-vehicle or combination of vehicles be equipped with brakes which shall be adequate to stop when traveling at a speed of 20 m.p.h. within the distance of 30 ft., or at a deceleration rate corresponding to such performance when all wheels are equipped with brakes. Specific recommendations were also read for the installation of air-brake equipment on motor-vehicles, stressing among other things the necessity of accessibility to mechanics, of avoiding the use of elbows, of care in use of pipe compounds, of proper installation leaving no pockets and having drainage toward reservoir, of proper cooling of compressors, of mounting brake chambers directly on the axles or backing plates and connected to the frame by hose long enough to allow for spring deflection. Mr. Faulkner also read some comments on vacuum power brake equipment submitted by W. B. Paine, Bendix Products Corp.

The final chapter of the report was on "The Operator's Woes on Lubrication," prepared by A. Ludlow Clayden, Sun Oil Co. Referring to Mr. Faulkner's paper of the same title presented at the 1936 Annual Meeting, Mr. Clayden divided the woes into three groups:

1. Variation in automobile manufacturers' lubricant recommendations.

2. Variations in chassis design necessitating the use of different lubricants for similar parts.

3. Variation in physical characteristics of motor oils and greases.

The length of satisfactory service which a motor oil will give, Mr. Clayden said, "depends very much more upon the engine than upon the oil. Engines injure oils in two ways; by overheating and contamination." In recent years overheating has been found to be most harmful, he added. He can see no reason why the automobile industry so steadfastly refuses to use oil coolers because an efficient oil cooler would increase the life of the oil, reduce the consumption of oil and would increase the life of the engine at least as much as the average combination of air cleaner and oil filter.

On the subject of viscosity Mr. Clayden made this remark, "The best economy in engine wear is to use relatively light oil and plenty of it. With low-viscosity oil less fuel is used, or conversely, higher power is developed; bearing temperatures are lower and bearing life is, therefore, increased; but oil consumption inevitably goes up."

Continuing, Mr. Clayden made pertinent remarks on extreme-pressure lubricants. He noted that the oil and the chemical ingredients work independently of each other. The most economical transmission lubricant apparently would be the SAE No. 90 type with a sufficient soap addition to give it satisfactory resistance to leakage, he said, noting however, "This falls down when E-P has to be considered." He said that he does not know any transmission in which the gears are sufficiently loaded to make E-P quality necessary, nor any transmission so constructed that it would be wise to supply it with the type of hypoid oil now being prescribed for many passenger cars. This is, he said, because "transmissions usually contain bronze parts and powerful hypoid lubricants will, all of them, as far as I know, get after brass like rats at a piece of cheese."

Harley Drake, Pacific Highway Transport Co., was chairman of the session. In opening it he introduced 1937 T. & M. Vice-President John M. Orr who outlined the plans of the Activity for the coming year.

The Transportation & Maintenance Activity, he said, will have four regional representatives in 1937. The East will be represented by George O. Pooley, Chesapeake & Potomac Telephone Co., Baltimore, Md.; the Central Region by Ralph Baggaley, Jr., McCrady-Rodgers Co., Braddock, Pa.; the Middle Western by F. L. Faulkner, Armour & Co., Chicago; and the West Coast by Fred C. Patton, Los Angeles Motor Coach Co., Los Angeles. Mr. Orr also announced the appointment of Pierre Schon, General Motors Truck Co., to head the T. & M. Activity student work; J. Willard Lord, Atlantic Refining Co., Philadelphia, to head the Fleet Safety Subcommittee; and E. Bennett, Bell Telephone of Canada, to be chairman of the new Foreign Contacts Subcommittee. Mr. Orr also announced that there will be a Public Utility Subcommittee but that its chairman has not yet been appointed. At the conclusion of the Activity business meeting members of the Nominating Committee were elected.

TBR Session Concentrates on Cooling and Transmissions

THE operating conditions imposed on a cooling fan have a more important influence on efficiency than the design of the fan itself, H. E. Winkler, Schwitzer-Cummins Co., stressed in his paper: "Factors in Engine Temperature Control," at the Truck, Bus and Railcar Session. This point was also emphasized by L. P. Saunders, Harrison Radiator Corp., in a prepared discussion.

Taking a specific case, Mr. Winkler told of a bus which was being redesigned so that there was considerable leeway in the selection and arrangement of the fan and radiator core. The following facts sketch what changes were made and what results were obtained:

	Original Design	New Design
Frontal area of core, sq. in.	750	940
Fan diameter, in.	24	26
Shroud	No	Yes
Fan speed to deliver 15,700 cu. ft. per min. r.p.m.	3050	1840
Consumption, hp.	19.3	6.2

In the original design, the fan operated at 1.33 times engine speed. The preceding figures indicate a permissible reduction in fan speed to 0.8 of engine speed.

The addition of the shroud increased the airflow 20 per cent with no change in power consumption, while the added core area cut its static resistance by about one third. The lower air velocity through the core also raised the final air temperature about 9 per cent. Longer belt life and less noise are other advantages of the new design.

With the present chassis design with the motor moved forward over the axle and the grille far in front of the radiator, Mr. Winkler pointed out, it is possible that sufficient room for satisfactory blade projected widths, fan-belt drives, bearing arrangements, fan discharge, and so on, be provided.

Mr. Winkler also traced the development of pump design and showed how the fundamental requirements for good design in this unit are being met. These fundamental requirements are: (1) the pump shaft must revolve on its axis and stay that way, (2) the sealing face must be driven positively in the plane of the seal, (3) sealing-face materials must operate inside the pump without lubrication in any coolant without appreciable wear, (4) sealing-face pressures must be within predetermined limits and must stay that way in operation, and (5) the sealing arrangement must not leak an appreciable amount of air.

In his discussion, Mr. Saunders covered various means of controlling cooling-water temperatures. He also stated that the additional cost of larger radiators would be more than offset by the reduction in gasoline consumption due to the decreased power needed to drive the fan. In connection with shrouds, he said that the distance between the face of the core and the fan should not be less than 4 in. and, in the case of an oblong core, a ring around the fan was preferable to a shroud.

An equally important feature of this session, at which Adolf Gelpke, Autocar Co., presided, was a paper presented by C. D. Peterson, Spicer Manufacturing Corp., entitled "Rear Engine Clutch and Transmission Developments" in the bus field. For the most part, this paper was descriptive, dealing with various arrangements and constructions now in use.

"Some problems in cluch design and application," Mr. Peterson said, "have been brought forth due to the fact that the driver is now located some distance from the engine with the result that he is unable to judge the speed of the engine closely by sound or feel. As a result the tendency is to start the vehicle with the engine running at a somewhat faster speed. The same thing applies on re-engaging the clutch after shifting gears. . . ."

Mr. Peterson said that this situation is being met by the use of clutches more capable of handling these severe conditions, and also that a further program of cluch development is under way which gives promise of providing a satisfactory solution. He also said that, due to the shortness of the drive line, it is much more rigid than in the conventional construction, which rigidity increases the effects of shock loading. This difficulty has been overcome by using a solid shaft with a long, polished reduced section to give the desired flexibility. On the quill type of transmission, the through shaft has a reduced, polished section for the same purpose.

From the discussion of Mr. Peterson's paper, it was evident that many of the problems of the rear-engine bus design arise from the fact that the driver is located so far from the engine, that he does not have the same knowledge and feel of what is going on. In this connection, it was mentioned that "Nitecoaches" on the Pacific Coast are fitted with microphone equipment to transmit engine sound to the driver and also that recording tachometers are fitted to check up on the actual performance of the drivers.

Tractor Major Influence on Farm Economics

"THE development of the automobile industry bears a close relation to the prospects in view for the tractor industry." This view was expressed by V. P. Rumely, Hudson Motor Car Co., in his paper "The Tractor, Brother to the Automobile," which was read by J. B. Macauley, Chrysler Corp., before the Tractor Session, Wednesday evening. Illness prevented Mr. Rumely from attending.

In both the automobile industry and the tractor industry many of the engineering requirements are closely related and can be accommodated by the use of similar alloy steels, heat treatment and other materials and processes, it was explained. Both industries are striving for lighter weight and subsequent cost reduction, higher engine speeds and lighter reciprocating parts, Mr. Rumely continued in pointing to the mutual ground for development. He also praised the tractor industry for its ability to surmount the many setbacks it has passed through – crop failures, floods, droughts and depressed grain prices. He sees new fields opening for tractors because of crop diversification, flood control, irrigation, and the scientific development of new farm products for industry. He also sees a future in industrial and construction work. "Each of these fields," he said, "has its particular problems and I am sure that the cooperative efforts of the tractor people, in conjunction with this Society's facilities, will result in a business expansion that proportionally, will excel the record of the automobile."

A. W. Lavers, retiring vice-president of the Tractor and Industrial Power Equipment Engineering Activity, was chairman of the session. Following the presentation of Mr. Rumely's paper, Mr. Lavers introduced Harry G. Davis, director of research, Farm Equipment Institute.

He vividly contrasted conditions in this country existing back in 1820, when there was no farm machinery and 83.1 per cent of our gainfully employed were on farms; to 1900 when the adoption of farm implements, such as seeders, harrows, threshing machines, decreased the gainfully employed on farms to 35.7 per cent; and to the present time, the age of mechanical power, when those gainfully employed on farms constitute only 21.5 per cent of the country's total. He contrasted the working conditions of the farmer, his home life, and the increasing freedom of his children from farm drudgery, permitting educational advances.

Agricultural mechanization has also contributed to the forward strides being made in other lines of endeavor by freeing men to help build up new industries, he declared, adding that if farm machines were suddenly taken away, and we returned to the conditions of 1820, more than 17,000,000 would have to give up their present occupations and start to grow food and clothing material.

In 1901, Mr. Davis stated, the first tractor powered by an internal combustion engine was built; now some 1,248,000 are on farms in the United States. The number of tractor manufacturers grew to 503 in 1915, but, as in the automobile

industry, the number has decreased and today less than 25 survive, he added. Tractor weights, he said, have dropped from an average of 508 lb. per rated belt horsepower in 1908 to about 200 lb. today. He emphasized that the all-purpose tractor of today is a far cry from the bulky machines of the past which were capable of delivering only belt and drawbar power.

He combatted arguments that agriculture is over-expanded with figures showing that in 1899 we harvested 3,726 acres of crops for every thousand of population as compared to 2,898 acres per thousand in 1929. Continuing, he said that it is doubtful if agriculture, without the aid of tractors and other power equipment, could have kept pace with our population which has increased 67 per cent in the past 36 years.

Mr. Davis made the startling statement that whereas it took 47 man-hours to harvest an acre of wheat in 1840 with the sickle and flail method, the same work could be done in 2 man-hours of work in 1934 with use of the combined harvester-thresher and motor trucks for hauling.

At the conclusion of Mr. Davis's talk motion pictures illustrated the application of modern mechanized farm equipment to the varying crops and conditions to be met with in this country, as well as at the extreme ends of the world. Several of the leading farm equipment manufacturers contributed to this picture which was collated by the Farm Equipment Institute.

Electric Eye's Scope in Modern Life

"THERE is too much pessimism in the world today," Dr. James S. Thomas, Chrysler Institute of Engineering, declared at the Junior-Student Session Monday evening. Opportunities, he said, are plentiful today, but they are harder to get at than they have been in the past. To reach them one has to have better training – a better outlook on life – and above all other things must not glorify defeat.

History, development and applications of the photo-electric cell – or electric eye – were briefly told by Ralph Powers, Electronic Control Corp., who shared the program with Dr. Thomas. Both men were introduced to the large crowd of students, junior engineers and SAE members by J. J. Frey, Ethyl Gasoline Corp., chairman of the session, and Detroit Section vice-chairman of the Junior-Student Activity.

Quoting numerous examples of how the United States has outstripped all other nations in progress since the Revolutionary War, Dr. Thomas noted that during those 140 years we have endowed and built more colleges and put more students in them than all the rest of the world combined. One quarter of our total population, he said, are following cultural pursuits and, he added, business is paying for this culture.

Among the amazing bits of history in the development of the electric eye, explained by Mr. Powers, is the fact that almost 30 years ago a patent was granted for photo-electric counting of pedestrians, horses, buggies and other similar moving objects. He also told of early discoveries in this field dating back to 1887 when Hertz noticed that an electric discharge passed more easily between two neighboring conductors when the negative electrode of the spark gap was brightly illuminated.

Talking motion pictures gave great impetus to the development of photo-electric cells, as it was found that with the sound track running on the film next to the pictures it was possible for a photo-electric cell to transmit the small variations in light area or light intensity coming through the sound track into electrical impulses, which could be transferred back into sound, he said. This meant better synchronization, and almost over night there was a demand for some 300,000 for use in theaters throughout the United States, resulting in extensive, fast-moving research, he added.

Among the simplest applications of the photo-electric cell to industry listed by Mr. Powers are the light relays for starting and stopping conveyors, counting, routing tote pans on conveyors, protecting darkened areas so that the interception of a beam of light will turn on the lights and the opening of doors upon the interception of a beam of light. He also explained how the use of photo-electric cells are being used as safety devices, speaking particularly of their application to a punch press. The electric eye, he explained, also serves industry by controlling heat treating, metal pouring and other processes requiring temperature control. Other applications mentioned include automatic inspection for flaws, cracks, or checks in bearings; discoloration, uncaught threads or lack of pile in pile fabrics. In concluding Mr. Powers said that all inspection problems where the human eye is being used at present can be solved by the electric eye, but in some cases the cost of the optics to make the electric eye follow the details of the human eye make the cost of the fixture too expensive to warrant its use. In the course of his paper Mr. Powers emphasized the low maintenance cost of these photo-electric cells. Demonstrations with photo-electric equipment accompanied the paper.

Knock-Rating Correlation Problems Analyzed

A NEW method of measuring cylinder-head temperatures accurately and a better understanding of the many factors that must be taken into account before laboratory and service knock ratings can be correlated, were the main contributions of the first Fuels and Lubricants Session, held Monday morning and, chairmanned by T. B. Rendel, Shell Petroleum Corp. The new method was introduced in the first paper: "A Sparking Plug, Adapted for Measuring Cylinder-Head Temperatures," by G. D. Boerlage and A. G. Cattaneo, both of Royal Dutch Shell Engine Research Station; and the knock-rating factors were discussed in the second and final paper: "Factors Affecting the Relative Knocking Characteristics of Motor Fuels in Service," by John M. Campbell, Wheeler G. Lovell, and T. A. Boyd, General Motors Research Corp.

"Difficulties of inserting thermocouples through cooling jackets led to temperature measurements through the spark-plug," explained Messrs. Boerlage and Cattaneo in their paper, read by A. G. Marshall, Shell Oil Co. Accordingly three methods of measuring cylinder-wall temperatures were tested simultaneously in the same spark-plug in a water-cooled and an air-cooled engine. The method with the thermocouple "in the face of the plug" that is, on the surface of the spark-plug rim exposed to the combustion-chamber, was found to give values "practically equal to that of the combustion-chamber wall." The other two methods, with an axially perforated central electrode and with the thermocouple soldered to the spark-plug washer, were found to be

inaccurate because of the influence of gas and cooling-medium temperatures.

Taking issue with the statement that the use of cylinder-wall thermocouples through the cooling jackets of liquid-cooled engines was "difficult or even impossible," S. D. Heron, Ethyl Gasoline Corp., explained that it could be done by installing a special gland.

"Have you data to prove that the spark-plug shell temperature is the same as the combustion-chamber wall?" inquired Prof. L. C. Lichty, Yale University, adding that he believed it to be higher because the spark-plug gets a greater effect of the hot gases.

From the angle of the spark-plug manufacturers, Otto C. Rohde, Champion Spark Plug Co., drew from considerable experience in measuring spark-plug temperatures, warning that gas leakage is the principal cause of inaccurate results, and that plugs should be sealed well against the excessive temperatures caused by it.

In answer to Professor Lichty, Mr. Marshall reported that no data were available comparing the actual cylinder-wall temperature with that of the spark-plug rim, but agreed that it would be desirable to obtain this information.

"Some of the reasons why two differing gasolines may knock just alike in one car or entirely different in other cars of the same make or of different makes," was given as an alternate title of the paper on knock-rating factors by John M. Campbell, Wheeler G. Lovell, and T. A. Boyd, and read by Mr. Campbell. By means of charts the paper showed that the question of whether a given fuel appreciates or depreciates in a given engine depends upon the reference fuel employed. Important variables discussed that explain why many fuels may have road ratings just the reverse of those found in the laboratory were engine speed, spark setting, mixture ratio, volatility, and whether the fuels are cracked, commercial blends, or straight-run reference fuels, as well as the antiknock compound used.

"The complexity of the problem increases tremendously," reported Dr. Graham Edgar, Ethyl Gasoline Corp., in written discussion, "when we add to the number of variables affecting the tendency to knock in a single-cylinder engine, the distribution problem of the multi-cylinder engine. The effectiveness of antiknock compounds is also affected by these variables and the volatility of the antiknock compounds plays a part in determining the effectiveness of distribution." The laboratories of the Ethyl Gasoline Corp. soon will present a paper on this subject, he concluded.

Confirmation of some of the authors' conclusions, but employing different cars and methods, was announced by L. E. Hebl, Shell Petroleum Corp., reading from prepared discussion written by T. B. Rendel and himself. The data on speed and spark advance were arranged so that shaded areas indicated the knock-intensity regions, so that they could be located at various speeds and degrees of spark advance.

"Spark advance," contended J. R. MacGregor, Standard Oil Co. of Calif., "is one of the most important and elusive factors in the correlation of road and laboratory ratings." He then recounted some tests where knock rating of a fuel varied 30 octane numbers with spark advance.

"Since Midgley and his associates invented detonation," recalled Frank C. Mock, Bendix Products Corp., "we have seemed to ignore that there is something else that happens except detonation – an attendant effect with pre-ignition or spark advance – and that the rate of flame propagation and temperature of the mixture must cut a figure in it."

Practical suggestions for eliminating variables when establishing knock ratings in the field were offered by Ulric B. Bray, Union Oil Co. of Calif., from experience in conducting tests in California. "Before starting the test," he advised, "put the distributor on a good set-up – determine its spark advance with speed; then check it after the test. It should check within ½ to 1 deg. Also check compression pressures and use the same temperature and humidity conditions."

Results of English research in detonation were shown by Richard Stansfield, Anglo-Iranian Oil Co., by means of oscillograms of smooth and knocking operation.

"What we are dealing with in detonation is really a chemical reaction that is not fully understood," contributed A. E. Becker, Standard Oil Development Co.

Claiming that the session had him "feeling a little dizzy," Arthur W. Pope, Jr., Waukesha Motor Co., simplified and related the many factors discussed by means of a knock intensity versus speed curve, thereby earning the gratitude of others more confused than he.

"Considering all the factors discussed this morning, it isn't any wonder that fuels behave differently in different cars," summed up Mr. Campbell to conclude the session.

In a short F. & L. activity business session presided over by the new Vice-President, C. Herbert Baxley, Socony-Vacuum Oil Co., a nominating committee was elected for 1937.

Fuels Group Stresses Knock-Rating Factors

EFFECTS of variations in altitude, humidity, and knock intensity upon knock ratings with recommended corrections or modifications comprised the subject matter for the second session of the Fuels and Lubricants Group, held Monday afternoon, of which J. B. Hill, Sun Oil Co., was chairman.

"Errors as large as 2 octane numbers" in knock ratings might be made by using the standard A.S.T.M. motor method, designed for sea-level conditions, at high altitudes, according to the paper: "Effect of Altitude on Knock-Test Ratings," by W. M. Holaday and G. T. Moore, both of Standard Oil Co. of Ind. Read by Mr. Holaday, the paper reported the results obtained by a small working group of the C.F.R. Subcommittee on Methods for Measuring Detonation, to correct this difficulty.

"At the higher altitudes," Mr. Holaday continued, "the density of the air is reduced and, when testing a fuel of a given octane number, it is necessary to use a much higher compression ratio than at sea level." Lack of regard for compression ratio has been partly responsible for variation in the results of cooperative samples tested at various altitudes, he explained.

"One logical means of correcting for altitude is to increase the volume of air admitted to the cylinder until the compression pressure at a given compression ratio is equal to that obtained at sea level," reasoned Mr. Holaday. Instead of supercharging, Mr. Holaday continued, the method selected was to eliminate the throttle plate and enlarge the venturi, thus obtaining the effect of forced induction. "At 5000-ft. altitude," he specified, "a ⅞-in. venturi instead of the conventional $^{9}/_{16}$-in. size, allows the same compression pressure at a given compression ratio as is obtained at sea level using the standard equipment."

"Some form of humidity control is required, especially for special-type fuels and those containing tetraethyl lead; adoption of 0.0135 lb. of water per lb. of dry air as a standard for all knock-rating tests is hereby suggested," concluded J. R. MacGregor, Standard Oil Co. of Calif., in his paper: "Influence of Humidity on Knock Ratings."

Data submitted by 20 laboratories in different sections of the country, he explained, show that during 1935 and part of 1936, the humidity varied over a wide range from 0.003 to 0.028 lb. of water per lb. of dry air, with an average value of 0.0135.

These variations in humidity, Mr. MacGregor believes, might explain many of the inconsistencies previously encountered in results among these laboratories. Results of special knock tests under controlled-humidity conditions showed that the knockmeter readings of all gasolines vary inversely with humidity in a straight-line relationship within the range studied or, in other words, their antiknock properties increase with humidity. Special fuels and those containing lead showed considerably higher sensitivity to humidity than the more normal fuels, Mr. MacGregor pointed out.

Seconding Mr. MacGregor's suggestion, Earl Bartholomew, Ethyl Gasoline Corp., in written discussion, reported: "Our studies of the variation of absolute humidity in various parts of the country have led us to the conclusion that Mr. MacGregor's figure of 0.0135 lb. of water per lb. of dry air is approximately correct." Confirming another of the paper's findings, he told of how it requires less lead to produce a given octane number in the Baton Rouge, La., fuel-testing laboratory of his company, where the humidity is highest, than at any other laboratory. Apparatus that uses ice for cooling and partial dehumidification, activated alumina for additional dehumidification, steam for humidification, and electric heaters for reheating, was described by Mr. Bartholomew to conclude the discussion.

Knock Rating Variations

"Knock ratings by the A.S.T.M. procedure may vary about 1 octane number when the knock intensity is changed over a range represented by a compression-ratio change of 0.2 from the standard ratio," concluded Neil MacCoull, The Texas Co., in the final paper of the session: "Effect of Knock Intensity on Fuel Knock Ratings." Also, Mr. MacCoull continued, the effect of knock intensity appears to be different on different fuels and the experimental micrometer bouncing pin shows practically no change in rating with the range of knock intensity covered, as compared with the standard bouncing pin. These conclusions were arrived at, he explained, only after a comprehensive series of tests, the results of which are tabulated in the paper.

"In a statistical analysis of 2000 tests, one fuel out of seven was found to be affected by humidity to the extent of 1 octane number," reported D. B. Brooks, National Bureau of Standards.

"The complexity of the problem and the increasing number of factors affecting it make us wonder whether our hopes of correlation will be realized as soon as is hoped," speculated Ulric B. Bray, Union Oil Co. of Calif., to conclude the session.

The Passenger-Car Lubrication Session, held on Thursday afternoon, was declared "closed" by W. S. James who acted as chairman. It was featured by a paper entitled "Extreme-Pressure Lubricants for Hypoid-Axle Gears," by W. R. Griswold, Packard Motor Car Co.

Diesel Operating Costs Bared and Debated

PERFORMANCE of Diesel engines was studied from three angles in the first Diesel Engine Session, held on Tuesday afternoon, that seems destined to contribute materially to the development of the compression-ignition engine. F. M. Young, Young Radiator Co., as chairman, introduced the authors of the session's three papers.

"The cost of Diesel fuel would have to increase 642 per cent before the fuel costs of gasoline and Diesel trucks would equalize," contends C. G. Anthony, Pacific Freight Lines, in his paper "Automotive High-Speed Diesel Engine in Heavy-Duty Transport," as read by L. G. Grunder, Richfield Oil Co. These figures, he qualified, are based on cost data covering the operation of 80 six-cylinder Diesel trucks and 161 trucks powered with gasoline motors in long-haul transport service on the West Coast. All of these trucks, he continued, were of the six-wheel ten-ton capacity type, pulling six-wheel ten-ton trailers. As the reason for this startling advantage of the Diesel truck, he explained that the Diesel engine runs twice as far on a gallon of fuel that costs 84.4 per cent less than a gallon of gasoline in California.

Even more surprising was Mr. Anthony's statement on maintenance costs, said he: "Recent maintenance costs for the fleet of 241 trucks show the maintenance costs of the Diesel trucks to be slightly less than those of the gasoline-motored equipment."

On the other hand, he continued, depreciation is higher for the Diesel trucks, and this charge affects the relative difference in the cost of operation of the two types of equipment very materially for a low yearly mileage and less severely as this mileage increases. However, when full costs were computed on a mileage basis, the Diesel trucks were found to be more economical by from $0.00505 to $0.03469 per mile depending on the miles run per year.

Agreement with most of Mr. Anthony's findings was voiced by both Col. A. W. S. Herrington, Marmon-Herrington Co., and B. B. Bachman, Autocar Co. Neither of them, however, could parallel his data on maintenance costs. "The average operator is not organized to maintain Diesel trucks so efficiently, and there is little chance that he will be," explained Mr. Herrington.

Explanation of the low maintenance costs reported by Mr. Anthony was offered by C. L. Cummins, Cummins Engine Co. "Usually," he stated, "the engine company helps to break in the maintenance departments. The type of operation, type of drivers, and the attitude of the operators toward maintenance all bear on its success. The long runs in Mr. Anthony's operation facing altitude, desert heat, and so on, require and receive organized maintenance service at both ends of the run," he concluded.

Successful use of Diesel trucks on short hauls in England, where Diesel fuels are costlier than in this country, was reported by James B. Fisher, Waukesha Motor Co. Mr. Fisher's statement was confirmed by Edward T. Vincent, Continental Motors Corp., who added that the costs of gasoline and Diesel fuel in England were about equal.

Mr. Anthony's maintenance costs were challenged by A. J. Scaife, White Motor Co., and others on the grounds that they compared new Diesel trucks with old gasoline vehicles, and did not include the cost of overhauling all the Diesel units.

"The important matter of taxes has been neglected in this discussion," warned Prof. C. Fayette Taylor, Massachusetts Institute of Techonology. "It is safe to assume that Diesel fuels will be taxed as much as gasoline, or as a tax per mile of service," he continued.

Referring to the title of his paper: "Correcting Diesel-Engine Performance to Standard Atmospheric Conditions," Prof. C. Fayette Taylor stated that he had no formulas yet for such a correction, but he believed that they could be developed at a given fuel-air ratio ratio based on tests of many kinds of compression-ignition engines.

"To show some of the variable factors in the problem and to give the results of research, is the purpose of the paper," he announced.

"The problem of correcting Diesel engine performance for atmospheric variations," he explained, "is more difficult than it is for the Otto-cycle engine as Diesel engines are operated over a wide range of fuel-air ratios whereas, in Otto-cycle engines, this ratio is held practically constant." Also he told how the combustion process in the Diesel engine is usually more sensitive than that of the Otto-cycle engine.

Results of tests on a single-cylinder sleeve-valve compression-ignition engine to determine the effects of variations in inlet pressure and temperature, reported by Professor Taylor, led him to conclude that the effect of a given change in atmospheric pressure or temperature on engine power is small with a low fuel-air ratio and increases as the fuel-air ratio increases. Finally, Professor Taylor concluded, the performance varies similar to an Otto-cycle engine at a constant fuel-air ratio.

"Why not determine correction factors from available air rather than from engine tests?" asked O. D. Treiber, Hercules Motors Co. In reply, Professor Taylor asked if the weight of the available air was known, and was it the same with density? Even with its errors, he believed the engine-test method better, he concluded.

"To show how the Diesel engine would operate at altitude and to compare this performance with that of the carburetor engine," is the purpose of the paper: "Compression-Ignition Engine Performance at Altitude Conditions," by Charles S. Moore and John H. Collins, Jr., National Advisory Committee for Aeronautics, according to Mr. Moore who read it.

"The altitude performance of both a supercharged and an unsupercharged compression-ignition engine would compare advantageously with a carburetor engine," was the conclusion formed after study of the results of an extensive series of tests on a single-cylinder compression-ignition engine for various combinations of inlet-air temperature and pressure to simulate altitude conditions, reported Mr. Moore.

"I believe that we get agreement with the data of Professor Taylor's paper up to a 14,000-ft. altitude," concluded Mr. Moore.

A nominating committee was elected in a short business session.

Naval Fuel Tests Feature Diesel Session

DIESEL fuel tests on a life-size engine and new operating-cost data comparing Diesel and gasoline trucks were reported in a thorough manner in the second Diesel Engine Session, held on Wednesday morning, at which A. W. Pope, Jr., Waukesha Motor Co., occupied the chair.

"Ignition quality beggars definition and is measurable only through its effects, and those effects are most vital in full-scale engines in field service," contends Lieut. Com. R. F. Good, U. S. Navy, in his paper: "Cetane Numbers, Life Size."

Using both a standard C.F.R. knock-testing engine and a full-size single-cylinder test unit made from standard operating parts of a submarine engine, he reported the results of 4000 hr. of tests on 100 doped and undoped Diesel fuels. The investigation was undertaken, Lieut. Com. Good explained, in order that revised fuel specifications might be written so that "engine performance could be maintained at the high standard required for Naval effectiveness." A single grade of fuel, available in large quantities in case of a National emergency, safe to handle in storage, usable in winter without preheating, with satisfactory performance with respect to starting, fuel consumption, smokeless combustion, and smooth running and without causing deposits, sludging, abrasion, or corrosion, is what we are looking for, he said.

Referring to the departure of some of his results on the full-size engine from those on the C.F.R. engine, Lieut. Com. Good believes that they are due to better combustion conditions in the life-size engine. "Evaluation of the ignition quality of Diesel fuels in service engines in the field by comparison with accepted standard reference fuels is possible; ordinary instruments and procedures are sufficient," he concluded.

Laboratory Engine Performance

"Welcome confirmation of theories held by some of us and rejected by others was furnished by the results of Lieut. Com. Good's paper," stated Prof. P. H. Schweitzer, The Pennsylvania State College, in written discussion. "The most interesting result," he continued, "is that the life-size engine is, if anything, more responsive to fuel ignition quality than is the laboratory engine." On the critical side, Professor Schweitzer pointed out that the three requirements of low pour point, high cetane rating, and production at non-premium price are difficult to reconcile because many crudes that have high cetane rating also have high pour point that can be lowered only by expensive de-waxing; he also questioned the accuracy of the oscillograph and pick-up employed in locating the ignition point. In answer, Lieut. Com. Good stated that he was aware of the incompatibility of some of the Navy specifications, but that these qualities had to be had as it was a military requirement beyond his control. Pour points will be specified, he predicted, as low as 45 deg. below zero. "Professor Schweitzer's criticism of the oscillograph is well taken," he added, "but we felt that errors would average out and that it would be accurate enough for its purpose."

In written discussion read by A. W. Pope, Jr., Charles S. Moore, National Advisory Committee for Aeronautics, discussed indicator cards obtained on a single-cylinder test engine under various conditions. "In these cards," he reported, "the entire pressure rise, if any, is quite a smooth curve and does not contain the well-defined burning period measured by Lieut. Com. Good, unless the whole pressure rise is considered." This difference, Lieut. Com. Good answered, is due to the difference in the two engine characteristics.

Although recognizing the value of Lieut. Com. Good's research, C. C. Moore, Jr., Union Oil Co. of Calif., "could not subscribe wholeheartedly to his major theses." His disagreement was chiefly with Lieut. Com. Good's conception of ignition quality and with his method of locating the ignition point and determining the explosion-pressure rise. His writ-

ten discussion was read by Ulric B. Bray, Union Oil Co. of Calif.

Fuel dopes claimed to improve the performance obtained with ethyl nitrate because of better startability were discussed by E. V. Beraslavsky, consulting engineer. In concluding his discussion, he pointed out the large gains that can be obtained in performance with the relatively small increases in cetane number, as can be obtained with dopes.

After expressing the appreciation of the C.F.R. Group to Lieut. Com. Good for his correlation work with the C.F.R. engine, T. B. Rendel, Shell Petroleum Corp., pointed out that many engines have a maximum cetane requirement in addition to the minimum cetane requirement discussed.

By means of oscillograms, R. Stansfield, Anglo-Iranian Oil Co., demonstrated that too much dependence on maximum pressure indications may lead one astray. Oscillograms showing engine strains indicated 30 per cent higher strains in one engine than another, whereas maximum pressures of the two engines appeared to be about equal.

"Undoubtedly yes, under favorable operating conditions," is the answer of B. B. Bachman, Autocar Co., to the oft-repeated question: "Can Diesel equipment be operated more economically than gasoline equipment?" as stated in his paper: "Diesel Engines in Trucks." But as such results do not always follow, he continued, our purpose is to find out why there should be such differences.

Of the units on which the paper gives cost data, Mr. Bachman reported that those in operation on the West Coast have shown the most favorable results in low operating costs. As to the reasons for these results, he suggests that on the West Coast there are fewer restrictions of size and weight, hauls are longer, the differential between the cost of fuel oil and gasoline is greater, and the fuel oil obtained on the Coast seems to be more satisfactory. Possibly also, the highly touted climate of the Coast may be a factor, he added.

"Before the normal expected life of Diesel trucks can be determined, more experience is needed," Mr. Bachman believes, stating that none of the trucks studied had been run over 100,000 miles.

Mr. Bachman concludes that Diesel trucks weigh more and cost more than gasoline trucks, that their maintenance cost is greater, that their fuel consumption is 50 per cent lower, and that Diesel fuels cost less depending on the section of the country and taxation.

Complimenting Mr. Bachman on his penetration and caution, Merrill C. Horine, Mack Trucks, Inc., in written discussion, deduced that "the definiteness of conclusions of other speakers seems to be in inverse ratio to the amount of information upon which they were based." In addition he pointed out the need for mileage experience beyond 250,000 miles so that a "narrow twilight zone" may be located above which the Diesel must reign supreme, and below which it can have no place.

Although a native Californian, J. R. MacGregor, Standard Oil Co. of Calif., took issue with Mr. Bachman's suggestion that the West Coast climate is a favorable operating factor. Transport routes take the trucks over scorching deserts and valleys, then over mountains where the temperature may be 40 deg. below zero; the trucks must encounter dust, ice, and snow, he explained.

To conclude the session, A. W. Pope, Jr., suggested that Diesel maintenance costs might be higher if the engine manufacturer were not helping to pay the bill. Then, taking the other side, he predicted that Diesel maintenance costs would be lower than those of gasoline trucks when they are perfected more. Discussing the possibility of taxing Diesel fuels on a ton-mile basis, Mr. Pope felt that such a tax should be discouraged as retarding efficiency and progress.

New Gust-Loading Data Stir Aircrafters

IMPORTANT data on gust loading just released by the National Advisory Committee for Aeronautics, the latest technique on aluminum-alloy welding, and a survey of future trans-oceanic transportation were the varied components of a stirring Aircraft Session held on Thursday afternoon. Mac Short, Stearman Aircraft Co., was chairman.

"The present design assumption of a sharp-edged gust as applied according to the laws of steady flow should perhaps be modified to allow properly for the effect of the gust gradient, as the important gusts encountered by airplanes under normal transport-operating conditions do not have very sharp gradients," concludes Richard V. Rhode, National Advisory Committee for Aeronautics, in his paper: "Gust Loads on Airplanes." The result of this modification would be to reduce the gust-load requirements on small, lightly loaded airplanes and to increase them on large, heavily loaded airplanes without affecting the specified loads for the "average" transport types currently used in this country, he continued.

"Severe thunderstorms or line squalls should be avoided by operators," he advised, "as it is impracticable to design for the severe gusts to be encountered in them."

Such conclusions, he reported, are the results of 3,800,000 miles of flying experience on land transports and flying boats equipped with "V-G recorders" or accelerometers that indicate the maximum accelerations on a smoked glass. These operations covered a territory embracing North America, South America, and the Philippine Islands, he explained.

E. P. Warner Discusses

Edward P. Warner, consulting engineer, discussed the paper implicated at some length. Mr. Rhode had largely eliminated, he pointed out, a discrepancy appearing in the past to exist between meteorological data and the rules adopted for gust-load conditions. Between the 30 ft. per sec. specified by the Department of Commerce or the 47 ft. per sec. that was the highest gust that a V-G recorder had ever indicated, and the 110 ft. per sec. that the Weather Bureau reported as having been *deduced* from the characteristics of certain storms, there lay a gulf disturbingly wide. Now that Mr. Rhode had shown that the effective velocity of a very intense gust was likely to be but half its true velocity, the 47 ft. per sec. became 94, and the gap remaining between that figure and 110 ft. was no longer wide enough to worry about.

That transport airplanes designed for standard structure conditions had been able on occasion to sustain such severe gust *exposures* without any sign of structural damage was most encouraging, Mr. Warner continued. It enabled us to regard the future with full confidence under substantially the present type of structural requirement. Undoubtedly in the most severe conditions a draft was made upon those hidden reserves of strength which were normally to be present, but which no analyst could introduce into his computations. The typical gust applied its load in a second or thereabouts, Mr. Warner said, and threw it off after an exposure of that same order. And undoubtedly a structure under those conditions

would actually carry considerably more load than had been calculated for.

Mr. Warner further suggested that an off-set for the increased gust-loads, to which Mr. Rhode found large airplanes inherently subject, might be discovered if we could secure more information regarding the dimensions of the typical gust. It seemed quite possible that the transverse dimensions of the area of maximum intensity might normally be small compared with the span of a large airplane, just as the normal length of an oceanic wave was known to be small when compared with the dimensions of a large vessel. The entire structure might not then be subject to maximum load at any given instance and some of the curves shown by Mr. Rhode on past experience indicated that the longitudinal dimension of the gust through which airplanes had flown had not in fact been very extended.

Mr. Rhode agreed that the dimensions were likely to be small but thought them hardly small enough to be less than the span of the largest airplanes now in service. He thought a 200-ft. diameter of maximum intensity quite likely; and agreed that the duration of gusts and the rate of entry was fortunately quick enough to increase the effective strength of the structure considerably while, on the other hand, it was slow enough to avoid that dynamic over-stressing concerning which airplane designers had often worried.

Ralph H. Upson, consulting aeronautical engineer, introduced the airship into the discussion and pointed out that it behaved like a very heavy load airplane and that the actual load factors imposed on it by gusts were correspondingly low.

Welding Aluminum Alloys

"The smooth outside surface that is obtained with spotwelded joints lowers the drag forces on airplanes as compared to similar riveted joints," pointed out G. O. Hoglund, Aluminum Co. of America, in his paper: "Spotwelding and Seamwelding the Aluminum Alloys." (Mr. Hoglund's paper is printed in full beginning on page 57 of the Transactions Section of this issue.)

Prof. F. K. Teichmann, of the Daniel Guggenheim School of Aeronautics, New York University, in written discussion, was optimistic regarding the prospects of spotwelding in precise structure in combination with a limited amount of riveting. He found particular reasons for optimism in German experience. It was not in the actual layer between the two sheets brought in contact, but in the absence of anything analogous to a rivet head that he thought spotwelding's critical property to lie. The absence of a head caused a little weakness in shear; and much more in tension; but even rivets were not good enough in tension for structures to be properly designed to make any joint bear that type of stress. The application of spotwelding to very large assemblies presented a large problem which, Prof. Teichmann says, is likely to limit its use at least to some time later.

Edward P. Warner sought the speaker's own opinion regarding the prospects of spotwelding in primary structure. He also wanted to know whether or not there were any particular alloys with which spotwelding was less satisfactory than with others; and whether or not in so-called "seam" or intermittent spotwelding, any trouble originated from overlapping of the spots. Other students of the same testing had decided that the spots contaminated one another when made in direct succession in close contact, and that seamwelding should be done by skipping about to leave substantial open spaces between spots made in direct succession and then fill in the gaps later. Mr. Warner also asked regarding the importance of very close timing on which there seemed to have been a conflict of opinion.

Mr. Hoglund's answer to all these questions was that spotwelding is not, in his opinion, quite reliable enough to be used in primary structure, but that the design data are so far insufficient. It is further testing rather than further metallurgical improvement that is required in that connection. It is by no means sufficient simply to put in welds in place of rivets whether on a one-for-one basis, or have several welds replacing each rivet. The designs must be fundamentally re-studied.

He considered spotwelding quite feasible with all the commonly used high strength alloys. There would be no trouble from the overlapping of spots, and the idea that skipping about was necessary, seemed to be an illusion. Mr. Hoglund thought the very close control of timing most important in metals where it would affect corrosion resistance. In the right alloy, where that probably would not arise, a variation of plus or minus of 50 per cent in the welding time is permissible, except in the special case of seamwelding where the control must be very close. In seamwelding it proved best to have the current on one-third of the time and off for two-thirds with the rotors feeding constantly.

John R. Cautley, of the Bendix Products Corp., who has been spotwelding the primary parts of wheels for some time, said he had experienced no trouble whatever. He had found timing control important but voltage control a good deal more so. Careful cleaning of the structure is most important of all. Anodic treatment was found to show up difficulties in the welds more than anything else, and where anodic treatment is used, Mr. Cautley has no fear of bad welds slipping through. As an example of the extent to which the technique was being currently used, he mentioned that the standard Bendix Pilot Seat contained 475 spotwelds.

Flying the Ocean

"Conquest of the North Atlantic – the most active oceanic trade route in the world – is the next step in the development of ocean air transport," predicted L. C. McCarty, Jr., Glenn L. Martin Co., introducing his paper: "Ocean Air Transport." In reaching out for this new field of flying-boat transport service, Mr. McCarty stated that the technical problems involved were complicated by delicate international, political and economic obstacles. For the next few years, however, he felt that the principal airway to Europe will follow the Southern Route.

Speeds up to 325 m.p.h. were looked for in the near future by Mr. McCarty to prevent serious losses and delays when operating against headwinds. As size increases, he predicted landings at higher speeds with lower loads on the structure and less discomfort. On a four-engined ship the chances of a forced landing are 1 in 100,000, he stated, discussing safety. Slides and motion pictures illustrating the China Clipper in construction and in flight were shown by Mr. McCarty to conclude the paper.

A. H. Kipfer, of American Air Lines, wanted to know what happened when driftwood was hit at 100 m.p.h. with large boats. Mr. McCarty thinks the best answer to that is not to hit the driftwood by keeping the regular landing places carefully swept and by having no forced landings elsewhere; it should be quite practicable with really large boats.

The airship's defenders flew to the rescue of their favorite

(Continued on page 64)

News of the Society

Says Cost of Airplane Engines Lower Despite Demands for Better Products

• Metropolitan

Airplane engines have shown a rapid decrease in cost during the past 10 years in spite of demands for higher manufacturing standards and closer tolerances, Henry C. Hill, senior engineer, Wright Aeronautical Corp., told the Metropolitan Section Jan. 18. Using the Cyclone engine as an example of the development of aircraft engines for military and civil use because of the availability of design, manufacturing and operation data, he said that many trends shown by this engine are representative of other transport powerplants.

Horsepower of this unit, which when first introduced in 1925 was 400 hp., had doubled by 1935 and is now nearly tripled. There were two increases in piston displacement during its early development, but since 1929 the bore has remained 6⅛ in., and the stroke 6⅞ in., with a total displacement of 1823 cu. in. He also pointed out that the horsepower curve has tended to show an even sharper rise in recent years. The pound-per-horsepower curve shows a downward trend, as does the specific fuel consumption curve in spite of the high and steadily increasing brake mean effective pressure, he added.

In 1928 both the frontal area and the weight would have been approximately double that of today's design to produce 1000 hp., and no airline would today be interested in attempting to do business with such a powerplant, he ventured.

Specific output, Mr. Hill said, had been achieved by engine designers largely by increased supercharging; increased volumetric efficiency and miscellaneous factors; increased engine speed, and greater compression ratios.

"It is an established fact that the supercharger cannot be used as a 'cure all' to cover up deficiencies in the engine," he said. "On the contrary, it is only by developing the engine itself to its highest possible efficiency that the benefits of supercharging can be fully realized.

"Improvement in fuel knock rating has been an important contributing factor in these increases in engine output," he continued.

Mr. Hill went on to say that detail refinement of practically every part of the engine has been made, revealing that 84 designs of cylinders were built and tested to bring about the five stages of cylinder development in the Cyclone.

A. V. D. Willgoos, chief engineer, Pratt & Whitney Aircraft division, United Aircraft Corp., East Hartford, described in detail the Twin Wasp SB3G engines, installed in the Douglas DC3 transport airplanes for the United Air Lines. Charles Froesch, North American Aviation, Inc., was introduced by Chairman T. C. Smith of the Section as meeting chairman. More than 200 members and guests were present.

Speedy Action Toward Uniform Trailer Hitch

Unanimous approval of proposals to be used as the basis for a standard on tourist-trailer couplings or hitches, marked action at the first meeting of a committee appointed under the Passenger Car Division of the SAE Standards Committee, held last month in Detroit. These proposals apply to couplings for utility trailers as well as trailers for touring purposes and, will be circularized to the automobile and trailer manufacturers for acceptance. As agreed upon by the committee the proposals are:

1. Unless the rear bumper of the towing car is designed to carry the coupling unit, the coupling unit shall not be attached to the bumper – it shall not be located outside of the bumper – and it shall allow a minimum clearance of 3 in. between the bumper bar and the unit.

2. From the safety point of view, the coupling connection to the trailer shall be above the bumper, not under.

3. There shall be two standard coupling sizes, No. 1 for gross loads on the coupling up to and including 5000 lb., and No. 2 for gross loads over 5000 lb.

4. There shall be a standard minimum strength test for couplings as follows: longitudinal tension and compression of 15,000 lb.; vertical tension and compression of 7000 lb., and transverse thrust of 7000 lb. for the No. 1 size coupling and twice these values, respectively, for the No. 2 coupling.

It was agreed that the dimensional part of the proposed standard should give only the bracket or mounting platform on the towing car to which the coupling unit would be attached. This platform for each car model would be designed or provided for by the car manufacturer, while the trailer manufacturer would furnish the coupling unit, including the

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ball that would fit into the standard platform. The following are proposed tentatively:

1. The upper surface of the platform shall be at least 18 in. and not over 20 in. from the ground with the car half loaded and before connecting the trailer.

2. The coupling platform shall be horizontal and shall be steel plate, $\frac{1}{2}$ in. thick plus $\frac{1}{8}$ in., minus zero.

3. The drilled hole in the platform shall be $\frac{3}{4}$ in., $\frac{7}{8}$ in. or 1 in. diameter for the No. 1 coupling and 1, $1\frac{1}{8}$ in. or $1\frac{1}{4}$ in. for the No. 2 coupling, the tolerance on the hole diameter to be plus 0.002 in., minus 0.000 in. (A single correct hole diameter for each size coupling will be worked out by the committee on the basis of the minimum strength requirements.)

The foregoing tentative proposals are being circularized to the automobile and trailer industries for study and constructive suggestions. These will be reviewed by the committee in preparation for issuing final recommendations by regular SAE standards procedure.

Those who attended the meeting were A. G. Herreshoff, Chrysler, chairman; Louis Thoms, General Motors; P. A. Weyl, Ford, and H. S. Jandus, General Spring Bumper, representing the automotive industry; and Clyde Beattie, Silver Dome; C. W. Schelm, Schelbro; E. C. Swift, Saginaw Plating, and W. V. Thelander, Silver Dome, representing the trailer industry. R. S. Burnett, Standards Manager, SAE; Donald Blanchard, secretary, SAE Engineering Relations Committee, and Jack Weed, editor, *Trailer Trade News*, also attended.

Declares Research Is Road to Progress

• Chicago

How far off is the perfect car? Today engineers ask, "Are we approaching perfection in engine performance? Will the problem of efficient fuel combustion be fully mastered? And how can we know perfection in these developments when it does arrive?"

These questions and scores of others were answered in terms of research methods and testing equipment by T. A. Boyd of the General Motors Corp., research laboratories section, before a gathering of 129 members and guests at the Jan. 5 meeting of the Chicago Section. Back in 1910, he said, one car maker advertised his product as "the perfect car"; yet measured by today's automotive standards how imperfect was his product. Progress is relative even in the fast-moving automotive field, he declared.

Researcher Boyd, who has spent no less than 18 years associated with Charles F. Kettering in automotive research activities, presented by pictorial slides and descriptive phrases a colorful tabloid review of the step-by-step evolution in self-moving road carriages. He traced the rudiments of automotive design as they developed from the early cumbersome carriages of the 18th century down to the first crude examples of highway vehicles propelled by the first practical internal-combustion engines. Mr. Boyd revealed that the principles customarily associated with the era of modern motor car engineering and design had their elementary counterparts in the early types of horseless carriages. He remarked further that inventive genius, aided by the development of new metallurgical materials, fashioned these embryonic automotive elements into a practical motor car, which, with the magic hand of research methods and testing appliances had been transformed into the smooth-working, efficient and beautiful motor car of today.

Continued advance in car performance and safety, Mr. Boyd declared, depends today, more than ever, upon highly developed laboratory research methods and improved appliances for testing and analyzing materials, fuel combustion and engine performance. Linked with scientific testing of new vehicles in large modern proving grounds, Mr. Boyd pointed out that continued refinements will be achieved in automotive design, construction and safety standards. Car tests on GMC proving grounds now total 8,000,000 miles yearly, and since 1925 GMC cars have rolled up 65,000,000 test miles, the speaker stated.

As typical of laboratory methods devoted to the study of fuel combustion, Mr. Boyd had projected on the screen, a slow-speed motion picture taken of the interior of a cylinder chamber with the engine operating at 900 r.p.m., showing the fuel explosion and action of gases when firing. This film is part of the study instituted by Mr. Kettering "to get the facts on fuel combustion if it takes his life-time."

William A. Sears, chairman of the Committee on Student Activity for the Chicago Section, introduced Speaker Boyd.

Explains Laboratory Tests on Lubricants

● No. California

Methods of bridging the gap between the chemist's test tube and the consumer of automotive greases were explained to 71 members and guests of the Northern California Section by J. A. Edgar, manager of the motor laboratory, Shell Oil Co., Martinez refinery, on Jan. 12. Laboratory tests, he said, have been devised which permit comparison of service characteristics of greases to be made more rapidly, economically and precisely than by road tests. The latter, he added, cannot be eliminated because they give the final answer.

Considering first the lubrication of spring shackles and other general chassis points at which pressure-gun lubricants are used, Mr. Edgar showed slides to illustrate the apparatus used to observe leakage characteristics of various greases as well as the effect of moisture on their performance. Besides these characteristics it is also necessary to determine the ease with which the lubricant can be supplied with standard types of greasing equipment, and its ability to lubricate for reasonably long periods of time without undue wear, he said. The almost universal use of screw shackles on passenger cars has made shackle lubrication less difficult, he added, stating further that it also makes the life of the lubricant longer. He explained that there is no definite correlation between retention of the grease and the viscosity of the oil used in the grease. Operation in the presence of moisture shows small difference between aluminum and calcium soap greases, he added.

Mr. Edgar spoke next on the question of universal-joint lubrication, explaining that the location of thrust surfaces, the location of grease seals and the type of grease seals used have a marked effect on the lubrication and the lubricant retention ability of the joint. He reported that his findings indicate that a high quality fibrous grease, sufficiently fluid and with the proper kind of oil to permit proper feeding to the surfaces will give better overall lubrication of needle bearing joints than will oil, because grease has better retention properties.

Speaking on wheel bearing lubrication he stressed the effect of improper bearing adjustment on the performance of the lubricant. Final adjustment, he said, should only be done by skilled mechanics as improper adjustment is apt to place loads of great magnitude on the bearings.

The practice of placing the steering-gear housing adjacent to the exhaust pipes, as is done in some cars, introduces the problem of having a steering-gear lubricant which will not leak unduly at high temperatures and which will not cause high drag at very low temperatures, he remarked. Present construction of steering-gear housings, he added, makes seasonal change of the lubricant impossible; hence an all-season grease must be used.

The apparatus used in testing the various lubricants, Mr. Edgar explained, weeds out those products which give good promise from laboratory, chemical and physical standpoints, but which are inferior in service. Those lubricants surviving the tests are further tested on the road, he explained, where they are subjected to a large number of uncontrollable variables in the great number of miles which must be run in different cars before correct conclusions can be drawn.

Standards Committee Acts on 40 Subjects

Reports on 40 subjects were brought before the Standards Committee by 12 of its 20 divisions when it met in Detroit during Annual Meeting week, reflecting the increased standards activity of the the Society during the past year. Most of the reports had to do with revisions or extensions of present standards to bring them up to date, and were passed upon by the Standards Committee and adopted by the Council.

Prominent among the revisions were a number of aircraft standards for commercial use that are related to the Army-Navy Standards of the United States military services. Revised standards for general automotive application include important specifications for automobile lighting equipment, considered a marked improvement over those superseded.

New standards adopted include dimensional standards for insert valve seats, and tractor magneto-flange mounting; test specifications for emergency electric lanterns for display by trucks and buses disabled on the road; specifications for clearance, marker and identification lamps; and a code for the inspection and adjustment of motor-vehicle headlighting equipment.

A new tractor testing code was reported by the Tractor and Equipment Division that has

also been approved and adopted by the American Society of Agricultural Engineers. The Standards Committee and Council also approved a Sectional Committee report on self-holding machine tapers for final approval as an American Standard under American Standards Association procedure. Cancellation of two current SAE Standards (Wire Loops and Ferrules for Aircraft and Poppet Valves, page 218 and 11 respectively, 1936 SAE HANDBOOK), was approved.

All of the new and revised specifications adopted will appear in the 1937 edition of the SAE HANDBOOK, now in the course of preparation, which will include all current SAE Standards and Recommended Practices.

The General Standards Committee Meeting was attended by Chairman C. W. Spicer, and Division Chairman: Robert Insley, Harte Cooke, L. E. Lighton, E. W. Upham, M. C. Horine, W. C. Keys, G. L. McCain, G. W. Curtis; Lighting Division Vice-Chairman R. E. Carlson for Chairman C. A. Michel, and Standards Manager R. S. Burnett.

Summer Meeting Trip Student Contest Prize

● Metropolitan

Engineering students in and about New York are sharpening their pencils, preparing to enter the student-paper contest which is being sponsored by the Metropolitan Section. The winner of the first prize will have the option of attending the Summer Meeting of the Society at White Sulphur Springs, West Va., with all expenses paid, or $50 in cash. Second and third prize winners will receive $25 and $10 respectively.

Any subject pertaining to automotive engineering may be chosen by the contestants. Papers may have between 2000 and 5000 words. Students entering the contest must register their subjects before Feb. 17, and submit their papers prior to March 24. Any registered engineering student in the New York metropolitan area may enter. Further information and official entry blanks may be obtained from the office of the Metropolitan Section, 29 West 39th St., New York City.

Hugh S. Cameron, Met Section Student Activity vice-chairman, announces that awards will be made to the prize winners at a student meeting of the Section to be held early in May.

Aircraft School Head Speaks Before Students

● N. Y. U.

C. S. Jones, president of the Casey Jones School of Aeronautics, gave an informal talk before 33 members and guests of the Student Branch at New York University, Dec. 17. He told of progress in blind flying and gave many personal experiences. Mr. Jones likewise answered a number of questions put to him by the students.

The Student Branch received the following bouquet from James R. Moody who conducts "The Slide Rule" column in the Heights News, N.Y.U.'s newspaper, "No other engineering society on the campus has sponsored such consistently interesting meetings in the past year or two as has the SAE."

Standardized Place for Engine-Chassis Numbers?

If an auxiliary plate carrying both engine and chassis numbers were placed in a standardized location on every car built, recovery of stolen cars would be much facilitated and European travel by Americans made less troublesome a good many members of the Gasoline Engine Division of the Standards Committee believe. The subject came up again at a recent meeting because the Automobile Manufacturers Association had made an inquiry about it.

Since such standardization gives little promise of meaning much unless used on practically every vehicle built, the committee is questionnairing each individual manufacturer of cars and engines to determine the sentiment of the industry as a whole as to the desirability of action.

Closed Meeting Held On Truck Developments

● Oregon

Interesting and valuable information dealing with "New Truck Developments," was presented at the Oregon Section's Jan. 15 dinner meeting, called to order by chairman M. E. Vande Water and "closed" to the general public.

Members who participated were O. E. Dagner, R. S. Rose and R. W. Mann. Mr. Dagner spoke on White and Indiana trucks, and also discussed the industry as a whole

and its problems. Having just returned from an eastern trip he was able to give a first-hand description of the labor problems confronting the industry. He also listed some of the more interesting mechanical improvements that came to his attention.

Mr. Rose gave a talk on GMC trucks and illustrated his remarks with a moving picture on the brake equipment of these trucks. Mr. Mann talked about the developments being made in the truck equipment field, and included many different phases such as equipment for logging, road construction and truck hauling. He, also, had just returned from the east. He described what was new at some of the plants he visited in Detroit.

Among those who took an active part in discussions were J. P. Seghers and G. P. Texada. More problems were submitted for the "question box." They were delegated to members for answering next month. A telegram was read from J. Verne Savage, the Section's delegate to the SAE Annual Meeting in Detroit, who declared it to be a big success.

About 25 members attended.

Phil Cogswell is the new Oregon Section field editor. He is filling the vacancy left by Sid Hammond who has been transferred to Seattle by his company – see item in "What Members are Doing" section, page 26.

Stout Talks of Future Before Joint Meeting

● Dayton

Meeting with the Engineers Club of Dayton, Jan. 18, the Dayton Section heard William B. Stout, president of Stout Engineering Laboratories and a past-president of the SAE, talk on the past, present and future of automobiles, airplanes and housing. More than 350 attended.

Describes New Method Of Surface Hardening

● Philadelphia

"The growth of intercity bus and truck service is in a way a measure of the development of the heavy duty engine and especially of the crankshaft," said W. E. Benninghoff, The Ohio Crankshaft Co., in presenting his paper on Tocco hardening, developed by his company, before 45 members and guests of the Philadelphia Section, Jan. 20.

He told of past efforts to produce wear-resistant bearing surfaces of crankshafts with a surface hardness which would withstand wear and abrasion without being subject to flaking or spalling, by carburizing, nitriding and other methods. All of these, he said, were found wanting in one particular or another. The Tocco process he said, meets these requirements and gives control of depth, width and location of the hardened area, absolute uniformity of hardening from bearing to bearing and crankshaft to crankshaft. He added that it also has a short time cycle to meet production requirements and is not expensive.

He briefly described the Tocco process as follows: "High frequency current of 2000 cycles is passed through an inductor block which surrounds but does not touch the bearing to be hardened. This high frequency current produces a very strong magnetic field which cuts the bearing surface through a small air gap, and induces eddy currents in the bearing surface. The magnetic field also creates hysteresis losses in the bearing surface. The combined eddy current and hysteresis losses, therefore, cause heat to be generated in the surface of the steel itself. The inductor blocks remain cold."

He further explained that due to the inherent reaction of the steel as its temperature rises, the heating effect decreases as the critical point of the steel is approached and consequently the steel is not overheated.

Mr. Benninghoff continued giving a more detailed description of the process and also reporting results showing that the life of crankshafts so treated to be materially longer than other shafts.

He was introduced by Adolph Gelpke, chief engineer, Autocar Co., who presided at the meeting.

European Body Studies SAE Steel Standards

SAE steel specifications are being considered by the Bureau Internationale de Normalisation de l'Automobile (Paris) which intends to establish in Europe general specifications for steels. Through the medium of the American Standards Association which represents the United States on the International Standards Association, the SAE Standards Department has supplied data outlining the extensive use of SAE Steels in the automotive industry, allied industries and other mechanical industries.

SAE Meetings Calendar

Summer Meeting

May 4-9
White Sulphur Springs, W. Va.

Tractor Meeting

April 21-23
Pere Marquette Hotel
Peoria, Ill.

Aeronautic Meeting

March 11-12
Washington, D. C.

Baltimore—Feb. 4
Longfellow Hotel; dinner 6:30 P. M. Metallic Wear – Paul S. Lane.

Buffalo—Feb. 9
Hotel Statler; dinner 6:30 P. M. – Subject – Hypoid Gear Lubricants.

Canadian—Feb. 17
Royal York Hotel, Toronto; dinner 6:30 P. M. Spring Design – F. P. Zimmerli, chief engineer, Barnes, Gibson, Raymond, Inc.

Chicago—Feb. 2
Hamilton Club; dinner 6:30 P. M.

Cleveland—Feb. 8
Cleveland Club; dinner 6:30 P. M. Rear Engine Drivers – Carl D. Peterson, executive engineer, Spicer Mfg. Corp.

Dayton—Feb. 18
Engineers Club; dinner 6:30 P. M. Extreme-Pressure Lubricants – Harry R. Wolf, Research Laboratories, General Motors Corp.

Detroit—Feb. 16
Statler Hotel; dinner 6:30 P. M. Subject – Factors Contributing to Economy of Operation of Passenger Cars.

Indiana—Feb. 11
The Athenaeum, Indianapolis; dinner 6:30 P. M. Safety – Burton W. Marsh, director of safety and traffic, Engineering Department, American Automobile Association.

Metropolitan—Feb. 8
The Roger Smith, 40 E. 41st St., New York City; dinner 6:30 P. M. Subject – Automatic Transmissions.

Milwaukee—Feb. 5
Milwaukee Athletic Club; dinner 6:30 P. M. Diesel Engines in the Zephyr – and Other Railcar Applications – E. F. Weber, superintendent of automotive equipment, Burlington Lines.

New England—Feb. 9
Walker Memorial, M. I. T., Cambridge, Mass.; dinner 6:30 P. M. Cast-Iron Crankshafts and Camshafts – F. J. Walls, chief engineer, International Nickel Co.

Northern California—Feb. 6
Fairmont Hotel, San Francisco; dinner 6:30 P. M. Annual Dinner and Dance.

Oregon—Feb. 12
Imperial Hotel, Portland; dinner 6:30 P. M. Report on Annual Meeting of the Society – J. Verne Savage, superintendent of shops, City of Portland.

Philadelphia—Feb. 10
Engineers Club; dinner 6:30 P. M. Automotive Transmissions and Torque Converters – P. M. Heldt, engineering editor, *Automotive Industries*.

St. Louis—Feb. 18
Jefferson Hotel, dinner 6:30 P. M.
High-Speed Diesel Trains—A. R. Walker.

Southern California—Feb. 19
Mona Lisa Cafe, 3343 Wilshire Blvd., Los Angeles; dinner 6:30 P. M. Servicing of Diesel Engines According to Manufacturers' Recommendations – C. L. Cummins, president, Cummins Engine Co.

Syracuse—No meeting

Washington—Feb. 9
Cosmos Club, Washington, D. C.; dinner 6:30 P. M. Subject – Fuels and Lubricants.

Papers from S.A.E. Meetings in Digest

So. New England Section Paper

Wednesday, February 12, 1936

Bridging the Gap Between Designer and Machine-Tool Man—*Alex Taub, development engineer, Chevrolet Motor Co.*

THROUGH the broad gap that exists between the product designer and the machine-tool man flows the stream of production. On one side of the stream are manufacturing ideas; on the other, product ideas. New ideas on each side of the stream must be welded into digestible form for the production department. If this gap were bridged, many an idea would live that today finds its way into the ash can.

The engineer expects from his shop progress along three distinct lines: voluntary reduction of tolerances; increased mobility for change; and a flexible viewpoint.

Variations may dissipate 25 per cent of the built-in rigidity of the crankcase. Machining variations in carburetors hinder fuel economy; fixed-jet carburetors vary 6 per cent or more in mixture-ratio strength. Friction and oil consumption also are at the mercy of tolerances.

Expensive immobile tools are the greatest obstacle to mobility for change. Disastrous results have followed attempts to adapt fixed-center equipment, such as cylinder-boring equipment with fixed heads, to new designs.

The solution to bridging the gap lies with the machine-tool makers, in the author's opinion. They can do it, he believes, by sending a good-will ambassador—an outstanding product engineer—to call on product designers.

Pittsburgh Section Paper

Tuesday, February 18

Principal Factors in the Brake Problem of High-Speed Diesel Trains as Related to Automotive Practice—*Joseph C. McCune, assistant director of engineering, Westinghouse Air Brake Co.*

THE problem of braking Diesel trains at high speeds is similar to that of automobiles but greatly magnified because of greater axle loadings, higher speeds, and more units. Stopping a Diesel train at 100 m.p.h. is equivalent to stopping the same train after a fall of 333 ft. The energy given up per axle in a Diesel train is about eight times that given up per axle when braking a motorcoach. The braking principle, however, is the same: a retarding force is set up that resists rotation of the wheels.

Rail vehicles cannot be stopped within such short distances as can road vehicles because of the lower coefficient of adhesion of the trains on rails, and because of the lower coefficient of friction of the chilled-cast-iron braking material used. The wheel-tread braking of rail vehicles is preferred over the drum braking as the same torque can be set up with a smaller frictional force.

Brake rigging for rail cars is cumbersome and heavy compared with automotive practice as the forces to be transmitted are tremendous and the members must be designed on a basis of deflection rather than strength.

Development of the air brake is traced from its invention by Mr. Westinghouse to the latest Diesel train design, including automatic safety functions, service applications, and emergency applications. An automatic means for reducing the shoe pressure as the speed decreases, called "Decelakron", is described.

Washington Section Paper

Monday, March 2

Recent Developments in the Rubber Industry—*Sidney M. Cadwell, director tire development, U. S. Rubber Products, Inc.*

THIS paper is confined to a discussion of developments and future requirements in tire engineering.

Since 1906 tread mileage has been increased four times and carcass mileage nine times while the tire price trend has been downward. With a total cost per mile one fifth that of 1918, it is estimated that the total saving in the period from 1920 to 1935 is 28 billion dollars—equal to the National debt.

Future tires will need: further improvements in mileage; better traction and skid resistance; greater stability; quieter tread designs; greater freedom from vibration; and better riding comfort.

Research has indicated that, on slippery surfaces, the tires will ride on a thin film of water or lubricant that must be squeezed out before there is resistance to skidding. Also a relatively large number of ribs in a tire tread increased skid resistance by reducing the distance that this liquid must travel to escape; these ribs act as squeegees to wipe off the road in resisting lateral skidding.

With cuts or slits across such ribs, further tests showed that improvements up to 30 per cent in skid resistance, also in traction on slippery surfaces and in hill climbing, resulted from this design change.

Baltimore Section Paper

Thursday, March 5

Some Recent Developments in Aircraft Engines—*Erwin H. Hamilton, professor in charge of automotive engineering, New York University.*

THIS paper compares developments in small aircraft engines of the manufactured and converted-automobile-engine types. Applications using converted Terraplane, Ford, and Plymouth automobile engines are discussed.

In the first a Ford V-8 engine is mounted in a two-place all-metal cabin monoplane built by Campbell Aircraft Co. with a 2:1 reduction gear replacing the flywheel. Fuel consumption is reported at 0.5 lb. per hp-hr.; engine cost is $1.17 per hp. without the reduction gear. The Plymouth engine is described installed in the "Plymo-coupe" built by Fahlin Aircraft Co. Fuel consumption is 0.648 lb. per hp-hr.; it weighs 5 lb. per hp.

The 100-hp. Terraplane engine has operated successfully in a 300-hr. test when driving the propeller through V-belts. Specific fuel consumption was 0.6 lb. per hp-hr., and the engine weighs 6.77 lb. per hp.

Small airplane engines are described of the following makes: Aeronca, Rover, Lambert, Popjoy, Kinner, Warner, and Ranger. These engines are rated at from 36 to 290 hp. with a weight per horsepower of from 1.7 to 3.3 lb. Cost per horsepower of these engines is from $10 to $18.75.

The author concludes that the use of converted automobile engines will further sales of smaller airplanes to individuals despite their weight, at least until the time that quantity production brings down the cost of smaller airplane engines. The aircraft powerplant of the future is visualized as a large evaporatively cooled compression-ignition engine completely enclosed in the wing and using a pusher propeller.

Metropolitan Section Papers

Monday, March 9

Sales Engineering—*R. H. De Mott, general sales manager, SKF Industries, Inc.*

IN this paper the author draws on 20 years' experience in sales engineering to set forth the advantages of sales engineering to the buyer. He defines sales engineering as an engineering service rendered to the buyer that helped in the consummation of the sale; thus its activities may range from calculations to involved research.

Examples are given to show how a sales engineer opened up a market for his products in an industry that had never used them by intensive study of his prospect's machinery and problems and how another sales engineer hurdled the price obstacle by solving a noise production problem in electric motors.

In the automotive industry, despite its large research and engineering

departments, sales engineering help is desirable because of the many years of accumulated knowledge in applying its products to many varied industries that the supplier has to offer.

Sales engineers are useful in checking customers' designs, in helping with production problems concerning their products, in correcting difficulties involving their products, in servicing buyers' units in the field when their products are concerned, and in carrying back to their companies suggestions for needed changes or improvements in their products.

Sales Engineering — *S. Johnson, Jr., chief engineer, Bendix-Westinghouse Automotive Air Brake Co.*

THREE types of selling are discussed: "friendly", "product" and "application". The last type is used by the successful sales engineer who is the confidential adviser and consulting engineer for his customer.

In addition to engineering education and practical engineering knowledge and experience, he must have the following requirements: practical, thorough knowledge of products; intimate knowledge of customers' problems; initiative to meet complications successfully; tact; ability to make permanent friends; and the ability to establish and keep the customers' confidence.

To fulfill these requirements considerable time in his company's design department and shop is necessary. Work in the service department or experience in customer industries assists in gaining important knowledge of customers' products.

Among the fundamental principles given that can be applied to sales engineering is that personal contact is a large factor in controlling businesses. Methods for successful cooperation between the sales engineer and his company's engineering and commercial departments are discussed fully.

In conclusion four fields of sales engineering important to the automotive industry are named: machine tools, motor-vehicle parts, motor-transport engineering, and service engineering.

New England Section Paper

Tuesday, March 10

Building Safety and Facility into the Roadway— *Maxwell Halsey, assistant director, Bureau for Street Traffic Research, Harvard University.*

ROADWAYS designed and constructed to eliminate the necessity for enforcement of traffic regulations are described and discussed in this paper.

The history of American roadways is reviewed from the "get-us-out-of-the-mud" stage to the present so-called "safer" roads. How automobiles have outstripped the roadways in safety and facility is emphasized.

The driver, responsible for 85 per cent of accidents, must be forced to drive safely by building safety into the highway.

Among elements of design set forth to bring this result are a minimum road width of 20 ft., with the four-lane highway preferred as safer and less congested; a surface that is not slippery when wet and is light in color; attracting slow traffic to outside lanes by "dual-type" highways; and raised center strips or parkways.

Detroit Section Paper

Monday, March 16

Trans-Atlantic Flight—*Lessiter C. Milburn, vice-president and assistant general manager, Glenn L. Martin Co.*

THIS paper traces the development of trans-oceanic commercial aviation and the features of planes designed for this service, especially those of the Clippers and China Clippers.

Over-ocean flight is now accepted by seasoned transportation leaders as a promising field for immediate exploitation. Since the first non-stop trans-Atlantic flight, 17 years have gone by waiting for airplanes that could carry a commercial load over ocean distances with reasonable reliability and give a good account of themselves when occasionally forced to land at sea.

The structure of the airplane itself explains the practical development of ocean transport. For example, Clippers require but a fraction of the power that would be necessary were they built to 1925 standards. The monoplane principle of designing large ships, the development of strong aluminum alloys, and greatly increased reliability of flight are other contributing factors. Clippers can maintain schedules with full load on three of their four engines, and on two engines with moderate load reduction.

Two important functions of the boat part of the ship are that it permits the airplane to take advantage of the universal unobstructed landing fields provided in bodies of water and permits the planes to land at sea.

Tests on "sea-wings" or lateral stabilizers developed especially for ocean travel are described. Explanation of the operation of modern flying aids employed in trans-oceanic service concludes the paper.

Notes and Reviews

THESE items, which are prepared by the Research Department, give brief descriptions of technical books and articles on automotive subjects. As a rule no attempt is made to give an exhaustive review, the purpose being to indicate what of special interest to the automotive industry has been published.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

AIRCRAFT

Full-Scale Wind-Tunnel and Flight Tests of a Fairchild-22 Airplane Equipped with a Fowler Flap

By C. H. Dearborn and H. A. Soulé. N.A.C.A. Technical Note No. 578, August, 1936; 19 pp., 25 figs. [A-1]

Charts for Calculating the Performance of Airplanes Having Constant-Speed Propellers

By Roland J. White and Victor J. Martin. N.A.C.A. Technical Note No. 579, September, 1936; 12 pp., 9 figs. [A-1]

A General Tank Test of a Model of the Hull of the British Singapore IIC Flying Boat

By John R. Dawson and Starr Truscott. N.A.C.A. Technical. Note No. 580, September, 1936; 11 pp., 20 figs. [A-1]

A Study of Autogiro Rotor-Blade Oscillations in the Plane of the Rotor Disk

By John B. Wheatley. N.A.C.A. Technical Note No. 581, September, 1936; 14 pp., 10 figs. [A-1]

The Stress Criterion of a Tension Member with Graded Flexural Stiffness

By Hans W. Kaul. Translated from *Luftfahrtforschung*, Vol. 13, No. 6, June 20, 1936; Verlag von R. Oldenbourg, München und Berlin. N.A.C.A. Technical Memorandum No. 804, September, 1936; 19 pp., 17 figs. [A-1]

General Considerations on the Flow of Compressible Fluids

By L. Prandtl. Translated from paper presented at Volta meeting in Italy, September 30, to October 6, 1935. N.A.C.A. Technical Memorandum No. 805, October, 1936; 25 pp., 10 figs. [A-1]

On the Relation between the Performance and the Loudness of Sound of an Airscrew

By Jûichi Obata, Sandi Kawada, Yahei Yosida, and Umeziro Yosida. Report No. 141 of the Aeronautical Research Institute, Tokyo Imperial University, July, 1936; 26 pp., illustrated. [A-1]

Einiges über Schalenförmige Flugzeug-Bauteile

By H. Wagner. Published in *Luftfahrt-Forschung*, Sept. 20, 1936, p. 281. [A-1]

This entire issue of *Luftfahrt-Forschung* is taken up by three articles dealing with stresses in monocoque structures. The first deals with such stresses as an equilibrium problem, considering both cylindrical and non-cylindrical structures, and covering particularly stresses at the point of application and at openings. The second discusses adjacent stresses set up by longitudinal forces in both open and closed profiles, and in stiffened and unstiffened structures. Compressive force in the direction of the axis and shear forces about the axis, and the modification of the latter by longitudinal forces are analyzed in the final article.

Les Suspension Elastique des Moteurs D'Aviation

By Maurice Julien. Published in *Journal de la Société des Ingénieurs de l'Automobile*, September-October, 1936. [A-1]

After treating theoretically the questions involved in the flexible mounting of aircraft engines, the author describes a type of flexible mounting embodying these principles now installed on more than 250 aircraft. It is said to have realized all the advantages of comfort and security to be expected from the vibratory isolation of aircraft engines.

Theorie des Flugzeugtragflügels im Zusammendrückbaren Medium

By L. Prandtl. Published in *Luftfahrt-Forschung*, October 12, 1936, p. 313. [A-1]

When the speed of a body moving through a fluid medium approaches that of sound, then the compressibility of the medium is of considerable importance. In this article is developed a theory covering the behavior of a wing in a compressible medium, similar to that developed in 1918 and 1919 for a wing in a constant-volume medium. A new formula is given, and the theory applied to a wing of infinite length moving with speed exceeding that of sound.

Tragflügeltheorie bei Überschallgeschwindigkeit

By H. Schlichting. Published in *Luftfahrt-Forschung*, Oct. 12, 1936, p. 320. [A-1]

On the basis of the propositions set forth by Prandtl with regard to wing behavior in a compressible medium, the author develops a wing theory for speeds superior to that of sound. In addition to wing and induced drag there is present at such speeds a hump resistance that is independent of the aspect ratio. Hump and induced drag are proportional to the square of the lift and dependent on the ratio of flight speed to the speed of sound. At these high speeds the lift-drag ratio is less favorable than in an incompressible medium. Three cases are dealt with in the development of the theory.

Airplane and Engine Maintenance

By Daniel J. Brimm and H. Edward Goggess. Published by Pitman Publishing Corp., New York and Chicago, 1936; 493 pp., illustrated. [A-2]

The authors set forth the following three purposes as those they had in mind in the preparation of this book: to serve as a home study course for the student mechanic; as an aid to the instructor and student in secondary schools, either public or private, training aviation mechanics; and as a reference and handbook for the licensed mechanic.

BODY

Motor Body Blue Print Technology

By George J. Mercer. Published by George J. Mercer, Detroit, Mich., 1936; 140 pp., illustrations bound separately. [B-1]

The author of *Motor Body Engineering* and *Motor Body Designing Problems* has, in response to a demand for initial information on blue print reading, brought out this book combining useful information for the body and die draftsman with instruction for the shop man. Mr. Mercer is a member of the Society and his articles and previous books on body designing are familiar to men in the industry.

ENGINES

Effect of Nozzle Design on Fuel Spray and Flame Formation in a High-Speed Compression-Ignition Engine

By A. M. Rothrock and C. D. Waldron. N.A.C.A. Report No. 561, 1936; 12 pp., illustrated. [E-1]

Details of the Construction and Production of Fuel Pumps and Fuel Nozzles for the Airplane Diesel Engine

By W. S. Lubenetsky. Translated from *Dieselestroyenie*, No. 6, Moskva, 1935. N.A.C.A. Technical Memorandum No. 803, September, 1936; 11 pp., 12 figs. [E-1]

Dieselmachinen VI

Published by the Verein Deutscher Ingenieure, Berlin, Germany. 150 pp.; illustrated. [E-1]

A well rounded view of the most important questions involved in Diesel engine design and operation is given in this collection of 31 articles recently appearing in *VDI* publications. They are classified into four groups: fuel supply systems, ignition, combustion, and complete engine designs. They are said to demonstrate that Diesel engine construction has now reached a point where it must, to a greater extent than previously, avail itself of the results of scientific research.

MATERIAL

The Alloys of Iron and Carbon—Vol. I Constitution

By Samuel Epstein. Published for The Engineering Foundation by the McGraw-Hill Book Company, Inc., New York and London, 1936; 476 pp. [G-1]

This monograph, the seventh in order of publication, has been prepared at Battelle Memorial Institute as a part of the Institute's contribution to Alloys of Iron Research. It constitutes the first portion of a correlation and critical summary of the world's knowledge on iron-carbon alloys, and covers constitution and heat treatment; a later volume will deal with the properties.

Corrosion Resistance of Metals and Alloys

By Robert J. McKay and Robert Worthington. Published by Reinhold Publishing Corporation, New York, 1936; 492 pp., illustrated. [G-1]

This is one of the American Chemical Society Monograph Series; it summarizes the facts on corrosion processes and rates.

Engineering Alloys

By Norman E. Woldman and Albert J. Dornblatt. Published by American Society for Metals, Cleveland, Ohio, 1936; 622 pp. [G-3]

The authors have made a careful compilation of the available data and information on practically all proprietary commercial and technical alloys manufactured in this country and on many alloys made in foreign countries. The book is devoted to data on the chemical composition, physical and mechanical properties, uses, and manufacture of proprietary alloys. The S.A.E. specification alloys, as well as a few others of general interest, have been included.

The Steel Physical Properties Atlas

By Charles Newman Dawe. Published by American Society for Metals, Cleveland, Ohio, 1936; 87 pp. [G-3]

A compilation of authoritative physical test data for the various types of plain carbon and alloy steels.

Petroleum Technology 1935

Published by The Institution of Petroleum Technologists, London, England, 1936; 263 pp., illustrated. [G-3]

Since 1924 the Institution of Petroleum Technologists has published in the pages of its Journal a series of annual reviews of the advancements made in the knowledge of petroleum technology. To make these reviews more readily available the I.P.T. has published them for the first time as a separate book, containing twenty-four articles.

Tag Manual for Inspectors of Petroleum

Edited by R. M. Wilhelm. Published by C. J. Tagliabue Mfg. Co., Brooklyn, N. Y., Twenty-third edition 1935; 142 pp., illustrated. [G-3]

The twenty-third edition of this handy manual is now available containing a long list of items of new material.

Theory of Lubrication

By Mayo Dyer Hersey. Published by John Wiley & Sons, Inc., New York and London, 1936; 152 pp. [G-4]

This book is based upon a series of public lectures on the mechanics of lubrication given at Brown University in 1934, and repeated at Yale University and at the Massachusetts Institute of Technology in 1935. These lectures, intended to give a scientific background of modern lubrication for a better understanding of the problems arising in practice, were attended largely by engineers from New England industries, instructors and graduate students from the scientific and engineering departments and accordingly are addressed to physicists, engineers, investigators, and teachers of engineering rather than directly to the undergraduate.

A well-balanced picture of the present state of development of the subject is presented with emphasis on the physical rather than the mathematical side. Extensive bibliographies are included.

Service Man's Guide to Automotive Lubrication

By J. Howard Pile. Published by The Chek-Chart Corporation, Chicago, Illinois, Fourth Edition, 1936; 114 pp., illustrated. [G-4]

This well-known guide has been almost completely rewritten in this present fourth edition and most of the illustrations are new.

MISCELLANEOUS

Les Etouffeurs Dynamiques de Vibrations

By Lemaire. Published in *Journal de la Société des Ingénieurs de l'Automobile*, September-October, 1936, p. 297. [H-1]

The author's thesis is that automotive engineering problems, aside from thermodynamics, and those of electrical engineering, are not only analogous, but identical. As an example, he develops from Ohm's law formulas and analyses applicable to dynamic vibration dampers. He urges that in research, for economy of both time and money, mechanical problems be treated according to electrical theory.

PASSENGER CAR

L'Evolution de la Construction Automobile

By C.-B. Brull. Published in *La Technique Moderne*, Oct. 1, 1936, p. 667. [L-1]

Weight reduction, exemplified by a decrease of more than 600 lb. in one six-passenger model, is said to be the outstanding technical development in this year's Paris automobile show, born in the midst of social difficulties so serious as to efface to some degree the engineering spirit. For the future are seen rear engine mounting, improved combustion chamber design for better fuel utilization and automatic transmissions. The author of this analysis of trends as seen in the show is President of the Third Section of the S.I.A. Other show articles deal with special steel and magnesium alloys, lubrication and safety.

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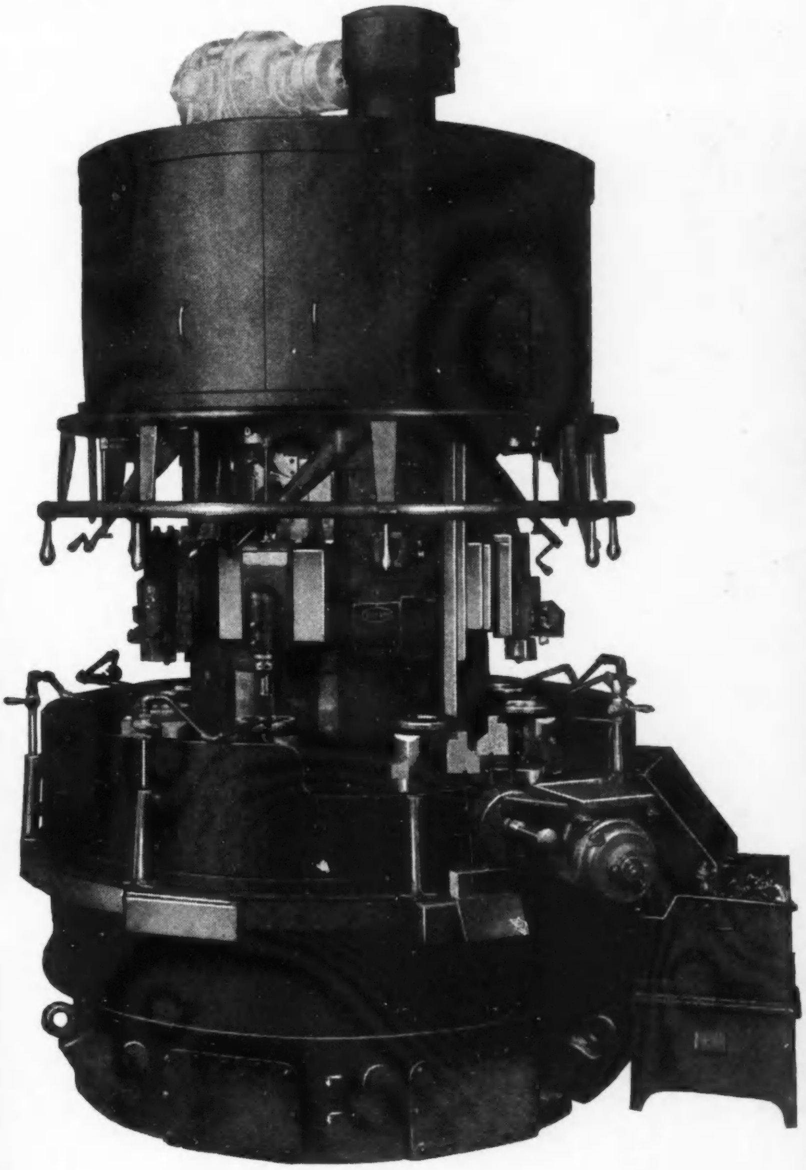

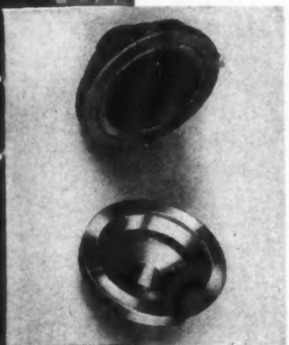

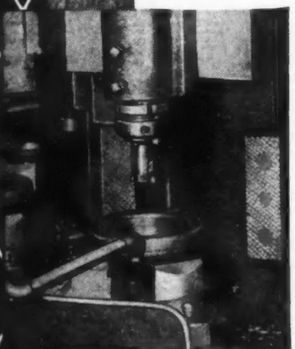

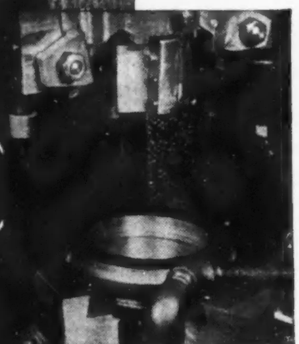

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Type	*Size*	*Spindles*
"D"	8″	6 and 8
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"J"	11″	8

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in the face of the speaker's high praise of the flying boat. Ralph Upson pointed out that airships could already span oceans commercially and would further improve along with the airplane. He foresees even better passenger accommodations than the *Hindenburg* now affords; cruise speeds for future airships of over 100 m.p.h. with normal operating altitudes higher than are common now; the use of auxiliary airplanes for pick-up and feeder service; and the universal employment of metal grade construction which the high speeds would necessitate.

Thomas A. Knowles, Goodyear Zeppelin Co., pointed out that the airship, by avoiding overnight stops on its oceanic way, can afford lower cruising speed, re-enacting the fable of the "steadily moving tortoise that passed the hare which had interrupted its race to sleep by the roadside." He diffidently called attention to the fact that the Graf Zeppelin five years ago had crossed the Pacific in better time than the regular trans-Pacific airplane service has yet been able to make, including its stops. The airship, he assured the audience, is so smooth that airsickness is unknown; but the public, and not the propagandist will finally decide. The airship was offered by those who know it best as a mass-transport vehicle which by furnishing mass service can be economical despite its high first cost.

Aircraft Engines— Materials and Output

THE Friday morning and afternoon sessions were devoted to Aircraft Engines. At the morning session, chairmanned by Opie Chenoweth, J. B. Johnson, U. S. Army Air Corps, Wright Field, delivered his paper on "Aircraft Engine Materials." In the afternoon, with Robert Insley in the chair, R. N. DuBois read, "High Output - And How?" a paper prepared jointly with Val Cronstedt. Both authors are in the Lycoming Division of Aviation Manufacturing Co. M. K. McLeod, Massachusetts Institute of Technology, followed, presenting his paper, "The Measurement of Engine Friction."

"The materials used for aircraft engine construction conform very closely to the standards published by the Society of Automotive Engineers," stated Mr. Johnson in opening his paper. "The allowable ranges for several chemical elements may be restricted or changed to meet special requirements or maintain better uniformity in the mechanical properties of the finished product, but these are minor only, and do not affect the basic classification of the material," he added.

In order of importance he listed the basis for selecting material for any particular engine part as: mechanical properties at the operating temperature; corrosion resistance of parts in contact with fuel or the products of combustion; uniformity, freedom from soft spots, heat treatment cracks and magnaflux indications; suitability for fabrication by methods and equipment available; machinability and cost.

Practically all failures in service, he noted, show typical fatigue fractures, but, to the author's knowledge a fatigue test has never been specified as an acceptance test for aircraft parts with the exception of the Stanton test, which at one time was required by a foreign manufacturer for forgings purchased in this country. The damaging effect of inclusions on fatigue strength is not acknowledged by all metallurgists, and it is a fact that parts which have given satisfactory service may indicate an inclusion content which would cause

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rejection under normal inspection, Mr. Johnson said, adding however, that studies of failures indicate that a low inclusion content is an additional safety factor in the selection of steel. Mr. Johnson used a number of slides to illustrate the results of magnaflux tests on 150 parts with varying service records.

Continuing, he discussed choice of steels and other metals and alloys for various engine parts, commenting also on test results.

G. D. Welty, Aluminum Co. of America, Henry Wysor, Bethlehem Steel Co., and G. A. Zink, Allison Engineering Co., contributed written discussion of Mr. Johnson's paper. S. D. Heron, Ethyl Gasoline Co., A. L. Beall, Wright Aeronautical Corp., H. K. Cummings, National Bureau of Standards, and F. C. Mock were among those participating in the oral discussion.

Answering a question on dampening Mr. Johnson said that at Wright Field they have no particular tests as to how much dampening affects the usability of aircraft parts. On chromium plating he said that the Army Air Corps is not using it on valve stems and other small parts. Tests in the past showed oxidation of the chromium at the valve operating temperatures and lack of adherence to aluminum alloys. He said, however, that there has been great improvement in chromium plating since these tests were made. Chromium plating for both hollow and solid steel propeller blades and for resizing worn or undercut parts has proven satisfactory, he said.

Regarding the use of magnaflux equipment Mr. Johnson explained that as they gain more experience they will better be able to determine when a defect due to inclusion will not cause failure, and when it will.

Most of the 3,000,000 gal. of high-knock-rating fuel to be consumed in 1937 will be used by airplane engines whose designs were developed on much poorer fuels and which have been gradually increased in output by detail improvements to make use of the increasing quality of the fuels, said Mr. DuBois in presenting his and Mr. Cronstedt's paper. The authors discussed in detail the possibilities of the high octane fuels from the standpoint of the designer who might be permitted to start from scratch. Chairman Insley complimented the authors on the exceptional quality of their paper and predicted that it will be a valuable reference paper for some time to come. As the paper was not circulated prior to the meeting there was no written discussion. Mr. Heron, Mr. Cummings, Mr. Mock, Edward T. Vincent, Continental Motors Corp., and Mr. Thompson, Skinner Motors, Inc., participated in the discussion.

Mr. McLeod introduced his paper on the measurement of engine friction by stating, "The motoring test method of measuring friction is admittedly weak, but it has the advantage of being practical and convenient. The object of this work is to determine the degree of error in the motoring test and to establish, if possible, a correlation between it and the true engine friction." Mr. McLeod went on to describe the apparatus used and the procedure followed in the study, which was undertaken at the Massachusetts Institute of Technology in the Sloan Automotive Laboratory. The conclusions reached were that the difference between motoring friction and engine friction in normal operation depends on a large number of factors which vary with engine design and operating conditions. Thus, he said, no good correlation of motoring friction with operating friction seems possible.

For routine friction tests, he continued, the motoring

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method is more practical and convenient, but for accurate friction measurements, and for studies with the object of reducing friction, the best method seems to be the use of an accurate indicator.

Written discussion of Mr. McLeod's paper was submitted by Charles F. Marvin, Jr., National Bureau of Standards, read by Mr. Cummings, and by J. George Reuter, National Advisory Committee for Aeronautics, read by Mr. Insley. Others participating included Mr. Cummings, Mr. Vincent, C. F. Bachle, Continental Motors Corp., K. J. De Juhasz, Pennsylvania State College, and Harte Cooke, McIntosh & Seymour Corp. The comments centered on the importance of determining the proper location of the top center line in taking indicator diagrams. The blackboard was in constant use to illustrate points made by the discussers.

Between the two papers presented during the afternoon session Mr. Beall, incoming vice-president representing the Aircraft-Engine Engineering Activity, conducted a short business meeting.

Budgeting Dissected in Production Session

DISCUSSION on budgeting methods so spirited that it carried the Production Session well over its official closing time on Friday night, followed a paper on budgetary control at several Chrysler plants. Advances in machine practice were surveyed in the other paper of the session of which K. L. Herrmann, consulting engineer, was chairman.

"To carry out effective expense control in automotive plants, the manufacturing program must first be translated into estimates of cost and then a positive control effected," advised George Miller, budget supervisor, Chrysler and Chrysler-Kercheval Plants, in the preamble of his paper: "Budgeting Expense and Cost of Handling Materials in Automotive Plants." "By positive control," he continued, "I mean catching the expense before the money is spent; otherwise it should be called 'remote control'."

Mr. Miller went on to describe the analysis and methods used to establish budgets and the administration of budget control at several Chrysler plants. Special emphasis was placed on budget control of material handling by Mr. Miller, telling in considerable detail of the receipt, transportation, and actual physical handling of the material in the plant and their relation to budget control.

"How are departments not controlled by plant activity – such as employment and planning departments – budgeted?" asked M. W. Burt, Midwest Abrasive Co., in the first of two prepared questions. In the other he wondered whether Mr. Miller's policy of contacting foremen directly concerning their department costs instead of their executives was not contrary to general operating principles.

"Such departments are budgeted on the basis of their own activities, the employment department on a rate per employe handled and the planning department based on the number of parts handled," was Mr. Miller's reply to the first question; "99 per cent of our problems are solved by foreman contact because, in contacting him, we travel the shortest possible distance in our effort to control," was his second prepared answer.

With a barrage of prepared questions anticipating those that might be expected to come from the floor, Joseph Stevens, budget supervisor, De Soto Motor Corp., drew out Mr. Miller

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to clarify further the detailed operation of his system of budget control.

"The strongest point about Mr. Miller's whole scheme," pointed out Joseph Geschelin, *Automotive Industries,* in prepared discussion, "is that all key men are definitely informed as to the performance of their departments."

"One cannot generalize the problems of budgetary control or materials handling," he concluded after pointing out how varying conditions at different plants determine the methods selected.

A system of budgetary control built around "the production man" that "establishes responsibility, effects accountability, estimates probability, determines advisability, insures desirability, and checks ability," was championed eloquently by John W. Brussel, Federal Mogul Corp., explaining how he originated the system after 25 years of experience with budgets. "It is so simple that a child can understand it," he explained, showing how the various expenses were broken down per productive man. Proudly displaying cost records, Mr. Brussel showed how closely he had been able to meet the budget per productive man in the depth of depression.

To eliminate comparisons between the two systems discussed, William B. Hurley, Detroit Edison Co., pointed out that each was well fitted to its type of plant – the one a large mass-production organization and the other a jobbing plant.

Today among automotive manufacturers, we see a greater difference in manufacturing processes than ever before, reported F. C. Pyper, Buick Motor Co., in his paper: "Developments in Close Machining Practice in Automotive Production." These differences have occurred despite the present policy of the various manufacturers to share experience because of varying conditions rather than because of differences of opinion on efficiency of equipment or methods of manufacture, he explained.

Evolution of machining practice in the automotive industry was accelerated by this policy of exchanging ideas, and is a tribute to the manufacturer, the machine builder, and the tool engineer, he concluded, after describing special machines and advances in the art of working metals in detail. Typical machines were illustrated by slides.

Speaking as "one privileged to move freely within the plants of the industry," Joseph Geschelin in written discussion, made the point that the interchange of ideas among plants has not resulted in any degree of standardization of practice, but rather has contributed to a general progressive movement. As a production process "revolutionary in character," he described applications of surface broaching of large surfaces where a multiplicity of milling machines formerly had been required.

Additional information on hole finishing by the grinding or precision-boring method was contributed by R. M. Lippard, The Heald Machine Co., reading from written discussion. "In internal grinding today," he declared, "it is possible to produce holes within a tolerance of 0.0002 to 0.0003 in. without any attention on the part of the operator other than chucking the work." Precision boring is the most accurate method known for cutting a hole, he believes.

Too much credit was given by Mr. Pyper to the toolmakers and not enough to the machine-tool builders, judged R. N. Brown, Packard Motor Car Co., in written discussion.

A survey of modern machining equipment and processes including considerable information not touched upon by Mr. Pyper was presented in the written discussion of W. H. Smila, Chrysler Corp., read by Mr. Geschelin.

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About Authors

• **Bruce Burns** *has had experience in the oil refinery equipment and pneumatic shock-absorber business; developed automotive steam powerplants; designed motion picture film handling and processing equipment and participated in the development of colored motion pictures since receiving his B.S. in M.E. from California Institute of Technology in 1920. He also had two years' wartime Navy experience, which, plus his five years' work on automobiles, developed his interest in aviation. He says, "I find plenty to do in the aircraft game, and that without touching aircraft."*

• **Stanley E. Knauss** *joined Gar Wood Industries in 1932 when that company purchased from Stout Engineering Laboratories, of which Mr. Knauss was an executive, the right to manufacture the light-weight chassisless coach designed by William B. Stout. Prior to that he spent 15 years with Mr. Stout, during which time he assisted in development of the Stout all-metal plane, and was manager of the Stout Air Line – the first passenger line in the U. S. When this line was merged with United Air Lines he became general traffic manager, in charge of operation from coast-to-coast.*

• **Richard V. Rhode,** *since receiving his B.S. degree in mechanical engineering from the University of Wisconsin in 1925, has been employed at the Langley Field laboratories of the National Advisory Committee for Aeronautics. Now a member of the N.A.C.A. subcommittee on structural loads and methods of structural analysis, he is in direct charge of the work on these subjects at Langley Field which has materially assisted in the formulation of design load specifications used in the United States.*

• **Max Roensch** *is a Texan. He was born in Geddings and received his B.S. degree from Rice Institute in 1926. The following year he attended the U. of Michigan. Leaving there with his M.S. degree, he immediately joined the Chrysler Corp., and started under J. B. Macauley who was then in charge of dynamometer work and engine development. Mr. Roensch is now experimental engineer in charge of Chrysler's*

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Publication Office, 56th and Chestnut Sts., Philadelphia, Pa.; Editorial and Advertising Departments at the headquarters of the Society, 29 West 39th St., New York, N. Y. Western Advertising Office, Room 2-136 General Motors Bldg., Detroit, Mich.

Engineer Is Caretaker of Future of Civilization

By Harry T. Woolson
President, Society of Automotive Engineers

ENGINEERING is a great profession. We are proud that it is our profession. There is always a new angle from which it can be considered. We like to think of its contribution to culture, to relief of human toil, to raising of the standards of living. It is often good for us to climb up for a mountain-top, long-range view. From there unimportant and insignificant items sink into obscurity and important ones stand out in bold relief.

At the Century of Progress in the great central hall of the marvelous Hall of Science, some of you may have seen quotations high on the walls in letters of gold. One read: "Nature does not proclaim her secrets aloud – she whispers them." These words from the pen of John Owen indicate the struggles of scientist and engineer using God-given minds to dig out the secrets of nature and harness them in the service of mankind, secrets so carefully hidden.

In recent years, there has been a growing tendency to limit the term engineer to those who have completed courses in engineering college or university, thus acquiring a sheepskin. Many famous engineers wrought great works long before educational systems, as we now know them, were in vogue. Many noted engineers in America today never played half-back, or gave a college yell. There will be many more of such in the future. This is not to disparage college training, rather to evaluate it correctly as an opportunity.

Consider for a moment that great engineer of a pre-historic age who turned his mind toward improving transportation and whittled out the first crude disc to form a wheel, thus enabling him to roll his burden rather than to carry or drag it.

Think of that engineer who, in more recent times, discovered the screw thread, thus contributing to succeeding generations an invention, without which we cannot conceive of the present civilization. The thought of industries, trades, structures and mechanisms of all kinds, dependent upon the lowly screw thread in some form or other, fires one's imagination. No one has ever discovered a substitute; it is a fundamental invention.

Soon after the beginning of the Christian era, when the European world was more peaceful, relatively speaking, some men with fine keen minds were able to turn their thoughts from war toward scientific investigation. With great toil, many of these scientists dug from the secrets of nature a

Harry T. Woolson
Executive Engineer, Chrysler Corporation

[This paper was presented at the Annual Meeting of the Society, Detroit, Mich., Jan. 14, 1937.]

number of its underlying principles. Many have endured to this day without change.

Following the scientist, often contemporary with him, came the engineer. The engineer used the fundamental principles uncovered by the scientists, applying them in a hundred practical ways to lighten human labor and provide unthought of comforts and luxuries.

We read the records of the struggles and hardships of these early men; of their successful battle against superstition and obstacles of all kinds. These records should heighten our appreciation and make us proud to be the successors of such a line of heroes, elected to carry on their civilizing labors. They contributed far more than the greatest generals and politicians.

Steam Power Has Great Effect

Approximately a century and three-quarters ago, a group of English engineers headed by James Watts conceived, invented and developed engines to harness the power of steam, previously but vaguely known. It is impossible to overestimate the impetus given to the world by this accomplishment, toward a higher order of civilization. With the possible exception of the printing press, no other achievement of man has so profoundly affected it. During the succeeding century and a half the civilized world, especially our own country, was covered with a network of steel ribbons. Transportation emerged from the horse-drawn centuries and proceeded into an era far exceeding fondest imagination. Again approximately a century ago – only the day before yesterday as historians reckon time – another group of inquisitive-minded individuals began exploring along other lines, destined to mark another milestone along the path of civilization being blazed by the engineer. I have in mind those early attempts to develop an internal combustion engine, culminating in success.

We can well afford to pause and consider the automotive situation in its many branches as we know it today. One may consider the development of alloy steels with their high and varied physical properties as all-important – and he is right. Another may think the discovery of rubber grown from the soil, the most important item – he also is right. We may be growing automobiles out of the ground in another generation – a suggested way to solve the farm problem.

In the above considerations, however, we miss the keystone of the past four decades of progress. It is an inspiring thought that the discovery and invention of the cycle of combustion now used, make possible the operation of hundreds of millions of cylinders all over the world today. That phenomenon, seemingly now so simple that a child can understand it, consisting of a suction stroke taking in a gaseous charge, compressing, firing for power stroke, and exhausting, was invented by those early men and it forms the keystone of all the vast structure of material civilization with which we are surrounded today. One result is that all civilized countries, especially our own, have been covered with a network of ribbons of cement. It is the reason we have the Society of Automotive Engineers. The names of those early inventors are rather hazy in our minds; some encyclopedias have little to say about them.

It is unnecessary to dwell further upon the importance of their work. We have not for a century improved on their fundamental ideas, only refining by change in combustion chamber shape, ratios, method of ignition, valving, etc. Would it not be a fine move for the SAE, some time in some way, to take steps to honor the names of those great engineers who have made possible our industry and likewise the profession we practice?

This march of modern civilization, this miracle of progress, we owe, in great measure, to the engineer. Let us briefly review certain benefits enjoyed resulting from his labors.

The founders of our country who first landed on these shores worked every daylight hour for a mere existence. Most of us can remember when ten and twelve hours a day at $2.00 to $2.50 was customary. Then came nine-hour days; followed by eight for six days a week; then eight hours with a half-day off Saturday, and now many plants work five days a week with wages doubled and trebled. The hours and severity of toil have been reduced in proportion to the advance in engineering inventions. At what point during the past few decades should new inventions have been declared unlawful to save the labor situation? Engineering spells civilization and must go on.

We have dwelt briefly on the beginnings of a great industry which has spread to all corners of the civilized world. Back in the horseless carriage days, our SAE was formed. Its independent formation was due to the opinion of then existing technical societies that automotive engineering was only a flash in the pan – undeserving of recognition by them. The new Society was a healthy youngster with small beginnings. It grew and expanded rapidly, keeping step with commercial growth of the business. It is unnecessary to take time for details in regard to the benefits conferred upon its membership and to industry at large. Suffice it to say the record of its standardization work alone justifies its existence.

Originally covering only passenger cars, it spread to commercial vehicles, trucks, buses, tractors, Diesel power and finally to aircraft and aircraft engines. It covers not only the design phase but also production in its many ramifications, including tool design and related equipment. It embraces fuel and lubricant problems, also operation and maintenance. The field has broadened from a small local Society to a great Society, international in scope. It has reached across the Northern border, extended hands across the Atlantic and Pacific and now counts its membership in 35 countries. It consists of 21 Sections located in all industrial centers – a Society of which we are justly proud.

Future Makes New Demands

However fine the history of past performances of any individual, company or society, one cannot rest upon past laurels but must push ahead toward new achievements. You have all noted upon the printed program announcing the 32nd Annual Meeting in January 1937, the shining symbol of a star. Looking forward to a year of greater usefulness for our society, that symbol seems to be leading us onward. Let us consider the achievements to which it beckons.

1. *The First Point of the Star is a More Powerful Membership*

We need to enlist within our ranks *all* automotive engineers qualified for membership. There are too many such outside those ranks today. It is not suggested that we should let down the bars of requirements for membership; rather those requirements should be stiffened up, and the quality of those accepted jealously guarded. Ours is a Society, engineering in name and function and should therefore, for success, have a strong backbone of engineering membership. However, we heartily welcome membership in the other

President Woolson Says –

"We are not merely designers and builders of automotive machinery. We are men and citizens whose lives and influence reach out into every major department of human life.

"We face today one fact most disturbing to every thoughtful man – that is, the readiness with which the forces of nature, as used in the mechanisms developed by the engineer, may be so readily diverted from the peaceful path of individual happiness to paths leading to destruction.

"The cycle of combustion previously mentioned lends itself to terrible destruction – certainly, in the not distant future, ways must be found to regulate the use of mechanisms, the children of men's minds.

"In efforts of this sort our Society should certainly take prominent leadership."

classifications. They have greatly strengthened us technically and contributed to our success in the past, and will continue to do so in the future.

2. *The Second Point of the Star is Accelerated Standardization*

Our standardization work is efficiently handled by committees aided by a competent staff. This work, to acquire greater momentum and extended usefulness, should have our hearty encouragement. Standards should be regarded as tools to aid industrial progress, not as a wall to restrict development. Standards, therefore, must be flexible, adjusting themselves to advance in design and research.

3. *The Third Point of the Star is Intensified Research*

Our Society has conducted many valuable research projects in the past and brought them to satisfactory conclusions. Much research work is of broad application and carried on cooperatively with other societies. This most important branch of Society activity has excellent leadership and should be encouraged in every way. Considering the small expenditures, returns have been remarkable.

4. *The Fourth Point of the Star is Vital Technical Papers*

The very life-blood of any engineering society is contained in valuable technical papers. It is important that past good work in connection with this vital factor in the life of our Society be given still greater emphasis. Ways and means have been discussed for promoting and encouraging the preparation of a greater number of valuable papers as a reservoir of technical knowledge available to the parent Society and Sections as desired.

5. A more powerful membership; accelerated standardization; intensified research; vital technical papers – these are all points of the engineering star. There is a fifth and last point to be added, namely *Broader Engineering Relations.*

Here is an aspect of SAE work which many of our members do not appreciate. The local meetings, the SAE JOURNAL and other reading matter, the standards, the research programs are not all there is to the SAE. More and more, as governmental agencies, both the law-making and law-enforcing varieties, multiply, are we called upon for technical advice. In this great field of transportation, touching as it does, the life of everyone in our land, there will naturally be much regulatory work required to guard the lives and health of the Nation. Each of our 48 States has a highway commissioner and staff working toward the safeguard of life and limb. The SAE has always taken leadership in advocating safety measures and is most anxious to be of assistance in promoting this work by giving unbiased opinions bearing on *technical* matters for the benefit of these commissions.

The SAE has always worked cooperatively with the Automobile Manufacturers Association, representing the managerial side, also with a number of similar associations in other industries.

A new headquarters division has been recently organized to handle more efficiently engineering relations, a most important aspect of SAE work. For success along these various lines we need the full power and backing of a great national Society and allegiance to it of *all* automotive engineers.

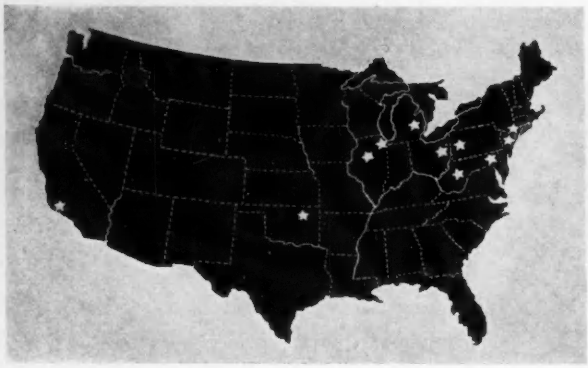
Engineering Star Rising

The star of engineering is still rising. Written across its face are the words of our slogan for the new year. These words are *"Greater Usefulness."* Engineers have not reached the end of the road – they have simply started on their journey. The rising generation may uncover a combustion cycle of greater efficiency than any known today. The fuel problem will face us more critically some years hence, and is to be solved. Efficiency in the use of materials is in its infancy with a goal to make every pound do its share of work. Friction is being attacked on every front – engineers would like to discover something to roll better than a ball. Scientific streamlining of cars is not at the end of its rope, there is still room for forms to glide through the air with the greatest of ease. Examples of beauty and grace in aircraft forms, with efficiency thrown in, are constantly before us. The Diesel cycle is making great strides and has had an uphill struggle, but truck, bus and railcar men are showing us the path to success. Diesel progress for aircraft is advancing. We are all quite familiar with its marine possibilities. These are but brief suggestions of a few items of unfinished business waiting to be attacked.

May I not add one other thought? We are not merely designers and builders of automotive machinery. We are men and citizens whose lives and influence reach out into every major department of human life. We face today one fact most disturbing to every thoughtful man – that is, the readiness with which the forces of nature, as used in the mechanisms developed by the engineer, may be so readily diverted from the peaceful path of individual happiness to paths leading to destruction. The cycle of combustion previously mentioned lends itself to terrible destruction – certainly, in the not distant future, ways must be found to regulate the use of mechanisms, the children of men's minds. In efforts of this sort our Society should certainly take prominent leadership.

A great star – our own particular star – shines before us. As we follow its leading we shall be helping to build a better and truer civilization and to usher in a happier day.

Coming



Washington . . . Peoria . . . Baltimore . . . White Sulphur Springs . . . Pittsburgh . . . Tulsa . . . Los Angeles . . . New York . . . Akron . . . Chicago . . . Newark . . . Flint . . .

All will be hosts to SAE regional or national meetings during 1937.

And other cities will also welcome the Society during the 14 meetings scheduled for this year.

Some of the dates and locations in this forecast of "Coming Events" are tentative, particularly those in the more distant future, but they serve to show that the SAE is on the march for 1937!

THE SAE is on the march for 1937.

Scheduled already are 14 national and regional meetings . . . more than 150 section meetings . . . and expanded programs for almost every one of the 52 technical committees.

Washington in March!

Right now aircraft men are clearing their desks to get away to the *SAE Aeronautic Meeting* in Washington, D. C., March 11-12. The government is a bigger factor, technically and commercially, in aircraft engineering than in any other SAE field – no small reason for the belief of SAE aircraft officers that the gathering at the Nation's capitol will be vital. Open house at the National Bureau of Standards will be a welcome event to Washington visitors. It takes place the opening day – March 11. Washington Section's Clarence S. Bruce, Thomas T. Neill and H. K. Cummings, all Bureau men, are in charge.

Each of the six sessions will bring authorities on technical problems facing the industry. Oil stability, for instance, will be treated by Dr. O. C. Bridgeman, chief of the National Bureau of Standards' lubricants and liquid fuels section. Ideas on design trends and how they affect ground facilities are to be discussed by Chief Airport Engineer L. L. Odell of Pan American Airways. This is sponsored by the American Society of Mechanical Engineers. Two Air Corps men, Weldon Worth and Ford L. Prescott, will give the Army's point of view on lubrication and cooling systems, and on aircraft-engine reduction gears, respectively.

These are but a few of the 14 current problems to come up for discussion. Among the other authorities reading papers we find Eastman Jacobs, National Advisory Committee for Aeronautics; Dr. D. P. Barnard, Standard Oil Co. of Indiana; Harlan D. Fowler, Glenn L. Martin Co.; S. D. Heron, Ethyl Gasoline Corp.; R. F. Gagg, Wright Aeronautical Corp.; W. L. Losson, also of Wright; Arnold E. Biermann, National Advisory Committee for Aeronautics; F. W. Caldwell, Hamilton Standard Propeller Co.; C. S. Draper and G. P. Bentley of M.I.T.; H. H. Wills, Sperry Gyroscope Co.; H. L. Brownback, and H. O. West, United Air Lines.

After two days of technical sessions comes the banquet. Arthur Nutt, not long back from a European trip, will talk about aviation engines being developed on the other side. SAE President H. T. Woolson is coming East to attend the meeting and will speak briefly. Welcome will be extended by Chairman Lieut.-Col. Burton O. Lewis of the Washington Section. C. H. Chatfield will take over the job of toastmastering.

Aircraft-Engine Vice-President A. L. Beall has been working steadily on the program ever since January, while the Aircraft Activity Committee has been equally vigorous in its action, despite the absence in Europe of its vice-president, Fred E. Weick. The Aeronautical Chamber of Commerce of America, the Air Transport Association of America, the American Society of Mechanical Engineers and the Institute of the Aeronautical Sciences are cooperating. The Washington Section will be host.

Next month, April 21-23, Peoria, Ill., will welcome a *National SAE Tractor Meeting* – and a two-day *Transportation and Maintenance* gathering is scheduled for Baltimore, Md., April 15 and 16. The transport crowd plans to concentrate heavily on problems peculiar to public utility fleets.

T. & M. Goes Utility

That means that T. & M. Vice-President John M. Orr's new subcommittee on public utility operation has had to get into action very quickly following its appointment in January, because this new group is being made largely responsible for the Baltimore gathering. Mr. Orr and his new specialty cohorts foregathered in Richmond on Feb. 3 to lay plans for the meeting. Then and there they decided to try to put into the program papers on truck bodies for line construction,

EVENTS

planned utility fleet operation, single-property fleet operation and an economy symposium featuring some of the most prominent public utility operating men in the country.

White Sulphur May 4-9

Then comes White Sulphur – *The Summer Meeting!*

It's going to be early this year – May 4-9.

And the old Monday-to-Saturday schedule is out. Instead the meeting will run from Tuesday to Sunday. People can attend without being away from the office so long. Fifteen sessions are scheduled – mornings and evenings only. Afternoons will be for recreation and special events. Technical sessions will be in the morning; general sessions at night.

Fuels Open Fall

Vice-President Herbert Baxley's *Fuels and Lubricants* Activity will take the Fall spotlight with a regional *Mid-West Meeting* in Tulsa, early in October. Set amidst oil fields which produce two-thirds of the nation's petroleum, this conclave gives promise of spreading interest to aviation, agricultural tractor and other groups active in the Oklahoma area. Held in Dallas last year, the Mid-West Meeting drew engineers from thousands of miles.

Attempts of 1937 aircraft production to top that of 1936 by 30 to 50 per cent point to another barrage of powerful aeronautical ideas when the *second National Aircraft Production Meeting* explodes in Los Angeles, Oct. 7-9. An innovation last year, this meeting was a "natural" in the aircraft industry. More than 650 crowded in from all over the country, sessions and the culminating banquet turned scores away for lack of room.

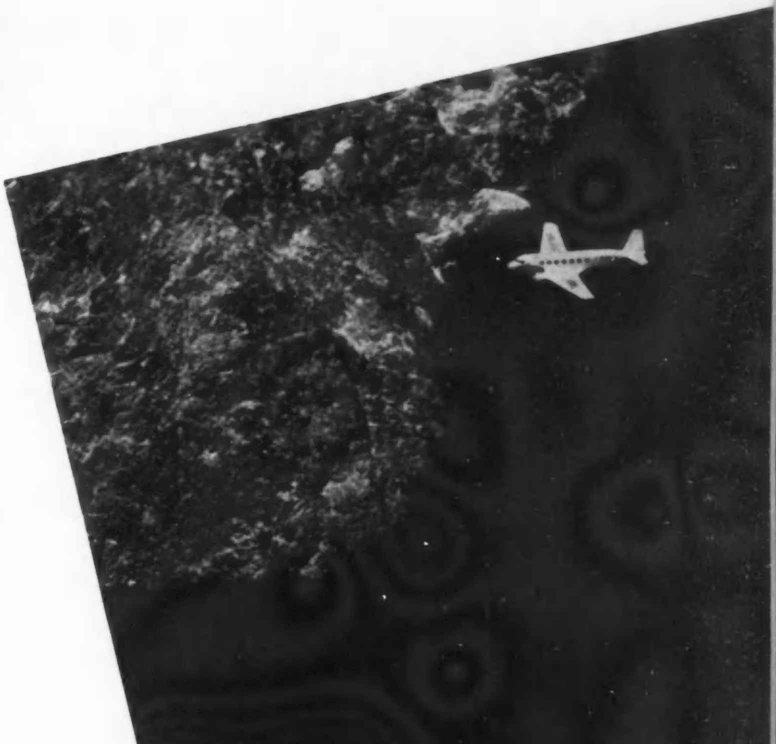
Oct. 27, the National Automobile Show opens in New York. The *SAE Annual Dinner* will be held the following evening, Thursday, Oct. 28.

Other Fall events (dates not yet definite) include *two tractor meetings:* one in Akron, in September, in conjunction with the Cleveland Section; and the other with the American Society of Agricultural Engineers in Chicago in December.

There will also be *three regional Transportation and Maintenance Meetings* in which the Truck, Bus and Railcar Activity will also participate. One of these will be in either Chicago or Pittsburgh, another on the West Coast and the third will be the Newark session held under the aegis of the Metropolitan, Southern New England and Philadelphia Sections, during the National Motor Truck Show.

Dec. 8-10 something new in production events is scheduled to happen. Production Vice-President R. R. Keith and his cohorts have tentatively chosen strike-torn Flint as the site of a *National Production Meeting* which will draw manufacturing men from a wide area. They will talk soberly and constructively of ways to build automobiles better – to the benefit of employes as well as management; of users as well as producers.

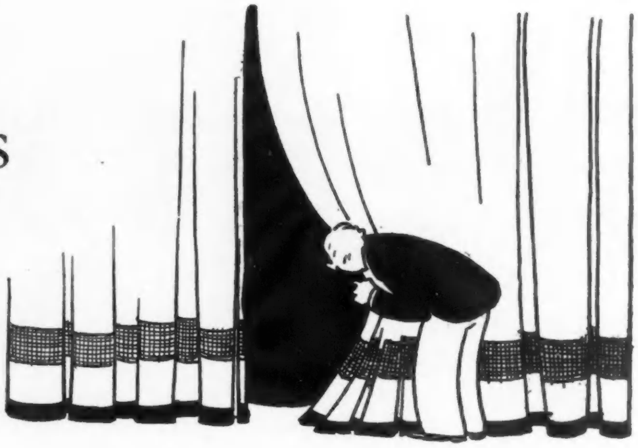
That will complete the meeting's cycle – and the *1938 Annual Meeting* will take its bow in January – as usual.



Courtesy of Transcontinental & Western Air, Inc.

Behind the Scenes

With the Committees



Correlation

THERE will soon be under way comprehensive tests under winter driving conditions to determine the correlation between car performance and knock ratings made in the laboratory. Approved by the Cooperative Fuel Research Committee, the program was developed by its Detonation Subcommittee. In preparation for this work an analysis has been made of all available road test data on 1934, 1935 and 1936 model cars. Coordinated programs of laboratory and test work will be followed individually by members of the C.F.R. Committee and Subcommittees, in cooperation with American Petroleum Institute's Automotive Survey Committee.

Oiliness Defined

"OILINESS is a term signifying differences in friction greater than can be accounted for on the basis of

viscosity when comparing different lubricants under identical test conditions."

This the Crankcase Oil Oiliness Research Committee approves as the definition of the term "oiliness." It was determined by a subcommittee, headed by Oscar C. Bridgeman. Its scope has now been expanded to include consideration of terminology in connection with wear and seizure measurements.

Riding Comfort

UPON completion of dynamic calibration of available riding-comfort instruments which meet the requirements as outlined in published reports of the committee (SAE JOURNAL, August, 1936, August, 1935), the instruments will be circulated to interested automobile manufacturers for field tests.

Oil Stability

THIRTY cooperating laboratories have agreed to participate in a new series of ring-sticking tests scheduled by the Crankcase Oil Stability Steering Committee, to be run on oil samples suitable for both automobile and aircraft engines. Six samples in all will be tested, two of commercial oils of high stability, two commercial oils of low stability and two oils, not necessarily commercial, of which one is of exceptionally high stability and one of exceptionally low stability.

After these oils are selected and purchased they will be shipped to the Waukesha Motor Co., where they will be coded, packaged and reshipped to the cooperating laboratories in such a manner as to avoid their identification.

Action

- **Circulation of oil test samples to 31 E-P machine owners to check operation of last ten machines with first 21 produced – E-P Lubricants Research.**

- **Combining one short and one detailed recommendation of inspection of steering mechanism into one recommendation that will call for detailed inspection when a vehicle fails to pass requirements of a preliminary wheel-play check – underway by Front-Wheel Alignment Research.**

- **The crankcase for a prototype single-cylinder aircraft engine is expected to be ready for delivery by Waukesha Motor Co., within 30 days – says Ignition Research.**

- **The Gasoline Survey Report for Summer 1936 was published early in February – by Cooperative Fuel Research in conjunction with the United States Bureau of Mines. *Copies available from the Bureau without cost.***

Change

THE Cooperative Fuel Research Committee has approved a recommendation to the American Society for Testing Materials for revision in the wording of the C.F.R. Motor Method (A.S.T.M. designation D 357 – 36T).

Discontinued

NO longer will Front Wheel Alignment Research collect, tabulate and distribute manufacturers' yearly wheel alignment specifications to trade publications. Discontinuance was voted at its Jan. 13 meeting.

Committees Appointed

SPECIAL committee to arrange changes in E-P lubricants testing machines – and to provide a stock of spare parts through the manufacturer, Highway Trailer Co. – *by E-P Lubricants Research.*

Two subcommittees to work up recommendations for specifications on igni-

tion cable for automobiles and aircraft, respectively – *by Ignition Research.*

Subcommittees to draft revised test procedure for further cooperative work and to analyze wear and stability data already obtained – *by E-P Lubricants Research.*

Three new T & M subcommittees are functioning. Chairmanned by Pierre Schon, one on educational activities will consider the extent to which educational work can be developed for the benefit of the Activity's membership, and to provide student branches with easily accessible national T & M contact. Another headed by J. W. Lord will undertake to correlate material pertaining to safe operation of vehicles in fleets. The third will have as its aim to give foreign T & M members a closer contact with activities on this continent. Ernest Bennet is chairman.

Modifications

THE Extreme - Pressure - Lubricants testing machine will be modified to meet recommendations suggested by those using the machine at the last meeting of E-P Lubricants Research.

SAE Meetings Calendar

Baltimore—March 4

Longfellow Hotel; dinner 6:30 P. M. Speaker – R. M. Critchfield, chief engineer, Delco Remy Corp.

Buffalo—March 9

Hotel Statler; dinner 6:30 P. M. Diesel Engine Progress – E. T. Larkin, chief engineer, Sterling Engine Co.

Chicago—March 5

Hamilton Club; dinner 6:30 P. M. Ladies' Night.

Cleveland—March 16

Cleveland Club; dinner 6:30 P. M. Speakers – Harry T. Woolson, executive engineer, Chrysler Corp., and president SAE, and John A. C. Warner, secretary and general manager SAE.

Dayton—March 18

Engineers Club; dinner 6:30 P. M. Improvements in Modern Dirigibles and Their Relation to Modern Commerce – V. R. Jacobs, manager, Aeronautics Department, Goodyear-Zeppelin Corp.

Detroit—March 1 and 15

Hotel Statler; March 1, meeting 8:00 P. M., Passenger-Car and Production Activities. Die Castings – C. R. Maxon, engineer, Market Development, New Jersey Zinc Co., Inc.; March 15, dinner 6:30 P. M., closed meeting for members only. Stainless Steel – Thomas Henkle; Use of Light Alloys in Body and Vehicle Construction – George McCarroll.

Indiana—March 11

The Athenaeum; Indianapolis; dinner 6:30 P. M. Diesel Engines – O. D. Treiber, chief engineer, Diesel Division, Hercules Motors Corp.

Kansas City—March 19

Hotel Kansas-Citean; dinner 6:30 P. M. Modernizing Moving Parts in Aircraft – Mac Short, chief engineer, Stearman Aircraft Co.; Hypoid Gears in Service – James A. Edwards, president, charge of engineering, Jesco Lubricants Co.

Metropolitan—March 8

The Roger Smith, 40 E. 41st St., New York City; dinner 6:30 P. M. Modern Trends in Motor Oil – Dr. G. M. Maverick, assistant manager, Research and Development Department, Standard Oil Development Co.; Contrast in Combustion – Neil MacCoull, research engineer, Texas Co. Harry T. Woolson, president of the SAE, and John A. C. Warner, general manager of the SAE, will be present at this meeting.

Milwaukee—March 5

Milwaukee Athletic Club; dinner 6:30 P. M. Modern Drivers for Modern Automobiles – Burton W. Marsh, director of safety and traffic, Engineering Department, American Automobile Association.

New England—March 4

Walker Memorial, M. I. T., Cambridge, Mass.; dinner 6:30 P. M. Diesel Bus Operation – H. Austin Murray, automotive engineer, Texas Co.

Harry T. Woolson, executive engineer, Chrysler Corp., and president, SAE, and John A. C. Warner, secretary and general manager, SAE, will also address this meeting.

Northern California—March 9

Bellevue Hotel, Geary & Taylor Sts., San Francisco; dinner 6:30 P. M. Fuel Economy Meeting.

Philadelphia—March 9

Engineers Club; dinner 6:30 P. M. Speakers – Harry T. Woolson, executive engineer, Chrysler Corp., and president SAE, and John A. C. Warner, secretary and general manager SAE.

Southern New England—March 5

Bond Hotel, Hartford, Conn.; dinner 6:30 P. M. Speakers – Harry T. Woolson, executive engineer, Chrysler Corp., and president SAE, and John A. C. Warner, secretary and general manager SAE.

Washington—March 11 and 12

Participation in National Aeronautic Meeting of the Society, Mayflower Hotel, Washington, D. C.

Summer Meeting

May 4-9
White Sulphur Springs, W. Va.

Tractor Meeting

April 21-23
Pere Marquette Hotel
Peoria, Ill.

Aeronautic Meeting

March 11-12
Mayflower Hotel
Washington, D. C.

National Aircraft Production Meeting

Oct. 7-9
Los Angeles, Calif.

T & M Public Utilities Meeting

April 15-16
Baltimore, Md.

About SAE Members:

Fred L. Smith has been made executive assistant to the president of the National Aeronautic Association, Washington, D. C. He formerly was director of aeronautics, State of Ohio, Bureau of Aeronautics, Columbus.

W. R. Hamer, who prior to the Spanish Revolution, was service manager, General Motors Peninsular, Barcelona, has been transferred to Mexico City, Mexico, where he is service manager of General Motors de Mexico S. A.

Leonard S. Wiener, formerly analytical engineer, Lycoming division, Aviation Manufacturing Corp., Williamsport, Pa., has started work at the Naval Aircraft Factory, Philadelphia, as junior aeronautical engineer.

R. D. Edwards has been transferred by United Air Lines from Cheyenne, Wyo., where he was superintendent, overhaul and repairs, to Chicago where he was made assistant superintendent of the eastern division.

I. E. Larkin, formerly sales engineer for the Dole Valve Co., has associated with Dirkes Industries, Inc., as a sales engineer in the Michigan and Ohio territory.

H. A. Brown is president and general manager of the Brown Chevrolet Co., San Francisco. He was previously vice-president and general manager of General Motors of Canada, Ltd., Oshawa.

F. H. C. Rutschow has been transferred from the experimental department of Atlas Imperial Diesel Co., Oakland, Calif., to the sales engineering department.

Stanley S. LaSha has been made vice-president and chief engineer of the Porterfield Aircraft & Engineering Corp., Kansas City, Mo. This follows his affiliation with the Crusader Aircraft Corp., with which he was aeronautical engineer.

William Waddell, formerly engine designer with Continental Motors Corp., Detroit, has joined the staff of Pratt & Whitney Aircraft Co., East Hartford, Conn.

C. C. Carlton, secretary, Motor Wheel Corp., will be the speaker at the dinner of the American Foundrymen's Association to be held April 9 during the fifth annual sectional conference of the Association at Michigan State College.

C. C. Carlton
Speaker

G. P. Texada, automotive engineer, Standard Oil Co. of California, has been transferred from Portland, Ore., to Walla Walla, Wash.

Archie T. Colwell has been made vice-president in charge of engineering of Thompson Products, Inc. With that company since 1922 he has been director of engineering for the past six years. Mr. Colwell is a member of the present SAE Council and last year directed the activities of the Cleveland Section as chairman. He graduated from West Point Military Academy as a distinguished cadet in 1918 and did post-graduate work in electrical and mechanical engineering at the Army Engineering School, Fort Humphries, Va.

Herbert J. Sargent is now with the Pioneer Instrument Co., Brooklyn, N. Y. He was formerly with the United Aircraft Corp., Sikorsky Aircraft division, Bridgeport, Conn.

F. B. Thompson has joined the Consolidated Aircraft Corp., San Diego, Calif., as draftsman.

William Littlewood, who last year was awarded the Wright Brothers Medal for 1935, has been made vice-president in charge of engineering by American Airlines. Since 1930 he had been chief engineer. Before joining American, Mr. Littlewood had been connected with Niles-Bement-Pond, Ingersoll Rand, Fairchild-Caminez Engine Corp., and Fairchild Engine Corp.

William Littlewood
Engineering V-P

T. S. Johnson, automotive engineer with Socony-Vacuum Oil Co., will sail from New York to Cairo, Egypt, on March 2, where he will join the company's Near East division. Mr. Johnson had previously been with Socony-Vacuum in Cairo, being transferred to this country in 1932. Since then he has been in the company's Brooklyn, N. Y., laboratory.

Keith Kelsey is secretary and treasurer of the Lanova Corp., New York. He was previously with National Parking Garages, Inc., also in New York.

Robert Insley, assistant director of research, United Aircraft Corp., is author of the article, "Characteristics of the Two-Row Radial Engine," appearing in the January, 1937, issue of *Aero Digest.*

A. R. Code, automotive engineer, Vacuum Oil Co., Pty., Ltd., Melbourne, Australia, has been re-elected president of the Institute of Automotive Engineers, Australia.

Herman E. Winkler recently resigned from the Schwitzer-Cummins Co., Indianapolis, of which he was chief engineer, to become vice-president in charge of engineering and sales of the Winkler Manufacturing Co., Lebanon, Ind. Mr. Winkler is a past-chairman of the Indiana Section.

H. E. Winkler
Makes Change

Edsel Ford and *William S. Knudsen* have been elected honorary members of the Engineering Society of Detroit.

Mitsutaro Ozawa has been made research engineer, automotive department, Tokyo Gas-Denki Kogyo K. K., Tokyo, Japan.

Charles Sardou, Jr., is chief draftsman, Vultee Aircraft division, Airplane Development Co., Downey, Calif. He was previously chief draftsman, airplane division, Kinner Airplane and Motor Co., Glendale, Calif.

Maj. M. V. Brunson, Quartermaster Corps, U. S. Army, who is taking a highway transport course at the University of Michigan, has recently submitted his thesis, "Operation of a Modern Taxicab Company," in partial fulfillment of the requirements for a Master of Science degree. A copy is on file at SAE headquarters.

Ronald J. Small has joined the engineering department of Consolidated Aircraft Corp., Lindbergh Field, San Diego, as detail draftsman.

Raymond L. Aumack is service manager, motor vehicle department, Branch Storage Co., New York. He was previously automotive engineer, New Jersey Motor Truck Association, Newark.

Samuel B. Farnum, Jr., former junior engineer with the Standard Oil Co. of New Jersey, New York, has been made assistant to superintendent of motor vehicle equipment, Delaware-Maryland-District of Columbia division, with headquarters in Baltimore.

Miss Amelia Earhart has announced that she will pilot her Lockheed Electra around the world at the equator. "I believe airplanes will soon be flying around the world as a routine matter along the same route I mean to follow," she said, adding, "I believe that the flight will be of value, just as I believe there have been benefits from every trans-oceanic flight that has been made." She will start from Oakland, Calif., "early in March," heading west.

. . . . At Home and Abroad

William B. Stout, president, Stout Engineering Laboratories and past-president of the SAE, is sponsoring a scholarship award, which carries one year's tuition at the Engineering College of Wayne University, open to high school students in the Wayne County, Mich., area. The scholarship will be awarded the student submitting the most valuable and original idea for improvement of private air transportation. Mr. Stout was recently honored by being elected a Fellow of the Institute of the Aeronautical Sciences.

Walter A. Hamilton, system maintenance superintendent for TWA and for the last three years chairman of the Aeronautical Chamber of Commerce and the American Transit Association maintenance committee, was selected as the recipient of *Aviation's* Maintenance Award for 1937. The publication presents this award each year in recognition of outstanding contributions in the field of maintenance.

W. A. Hamilton
Receives Award

Parry H. Paul, formerly with the Atlantic Refining Co., Philadelphia, has joined the engineering staff of the Autocar Co., Ardmore, Pa.

H. V. Gill is assistant supervisor, rail motor cars, Santa Fe Railway Co., Albuquerque, N. M. He previously held a similar position with Santa Fe in Topeka, Kan.

W. P. Meeson has been made general manager of Triumph Co., Ltd., Gloria works, Coventry, England. He was formerly general manager of Blackburn Aircraft Co., Yorkshire.

John W. Prinkey, formerly service engineer, Overseas Motor Service Corp., has been made sales engineer, General Motors Corp., export division, New York.

John J. Nargi has joined the engineering department of Olds Motor Works, Lansing, Mich. He was previously with the International Motor Co., Plainfield, N. J., as draftsman.

N. W. Devitt, president, National Automotive Parts, Ltd., Toronto, is 1937 president of the Canadian Automotive Wholesalers Association.

Sydney Edgar Willett, heretofore commercial manager, Clayton Dewandre Co., Ltd., Lincoln, England, has been made joint general manager of that company.

Peter Bukoff has joined the engineering staff of Barkley-Grow Aircraft Co., Detroit. He was formerly layout man with Douglas Aircraft Co., Santa Monica, Calif.

Ferdinand Jehle has joined the Hoffman Specialties Co., Stamford, Conn., as director of laboratories. He was for many years research engineer with the White Motor Co., Cleveland. Active in the Cleveland Section, Mr. Jehle was editor of its *Junior Journal.*

M. H. Clarke, formerly district retail manager, charge of service, Socony-Vacuum Oil Co., New York, has joined Sears-Roebuck in Chicago.

Donald L. Bower has been made chief, planning section, War Department, U. S. Engineer Office, New York. He was previously assistant to chief, engineering division, of the same office.

R. R. Higginbotham is project engineer with the Seversky Aircraft Corp., Farmingdale, N. Y., specializing in powerplant installation work. His former connection was powerplant installation engineer with Chance Vought division of United Aircraft Corp., East Hartford, Conn.

Robert Ketcham, a former student at Purdue University, has joined the Caterpillar Tractor Co., as apprentice engineer. He will be located in Peoria, Ill.

A. H. Chenault, engineer with Ethyl Gasoline Corp., has been transferred from San Francisco to Los Angeles.

B. B. Bachman, vice-president in charge of engineering, Autocar Co., has been issued a broad patent on motor vehicles of the engine-under-the-seat type according to a news report which states, "This is motor vehicle patent No. 2064100 issued under date of Dec. 15, 1936. The object of the invention is said to be to provide greater maneuverability, greater pay-load capacity with better weight distribution, greater comfort and convenience to the driver, and to make the engine more accessible."

S. Ward Widney is vice-president and general manager of the Ride-O-Graph Corp., Brooklyn, N. Y. He was previously director of engineering, B. & J. Auto Spring Co., also in Brooklyn.

S. Ward Widney
New Affiliation

C. H. Trollope who was technical engineer of the Chrysler Corp., export division, for Australia and New Zealand, now is affiliated with Chrysler Dodge Distributors (Australia) Pty., Ltd., Melbourne.

Delmar D. Robertson, former chief engineer of Wilkening Manufacturing Co., Philadelphia, has joined the Spicer Manufacturing Corp., Toledo, in a sales capacity.

William F. Barge has joined the Aviation Manufacturing Corp., Williamsport, Pa., as chief tool engineer. He was previously tool engineer with Wright Aeronautical Corp., Paterson, N. J.

Arthur E. Bausenbach, who was sales manager in charge of wholesale sales, Nilsen Automotive Electrical Service Co., Oak Park, Ill., is now with John Bean Manufacturing Co., Lansing, Mich., as salesman.

Lyman P. McIntosh, formerly sales engineer, Stolper Steel Products Corp., Milwaukee, has been made president of Maysteel Products, Inc., Mayville, Wis.

F. C. Crawford, president Thompson Products, Inc., has been elected to the executive committee of 25 which will direct the 1937 Great Lakes Exposition, opening at Cleveland, May 29. Mr. Crawford has also been elected vice-president of the National Aeronautic Association.

F. C. Crawford
On Executive Committee

Walter S. Rogers

Walter S. Rogers, a member of the Society since 1926, died Jan. 16. Mr. Rogers, after graduating from high school in 1909, worked for five years as apprentice machinist and machinist before entering the University of Michigan in 1914 where he specialized in internal combustion engines. His college course was interrupted by the World War. In 1917 he entered the Army Signal Corps and was later transferred to the Air Service where he did considerable work in connection with the Liberty engine and later in the supervision of Liberty engine installation in DH-4 planes. He returned to the University of Michigan in 1919 and graduated with his B.S.M.E. that year. He immediately joined the White Co., as assistant repair service engineer. Continuing at White he became export service manager in 1931, remaining in that position until joining the Chrysler Export Corp., in 1935 as service manager.

News of the Society

> ## S.A.E. National
>
> THE MAYFLOWER
> WASHINGTON, D. C.
>
> ### Thursday, March 11
>
> **10.00 A. M. Fuels and Lubricants**
>
> A. L. BEALL, *Chairman*
>
> What an Octane Number is Worth in the Air – D. P. BARNARD, *Standard Oil Company of Indiana*
>
> Engine and Laboratory Tests of Stability of Aviation Oils – O. C. BRIDGEMAN, *National Bureau of Standards*
>
> **1.30 P. M. Inspection Trip**
>
> Inspection trip through the National Bureau of Standards Laboratories.
>
> **8.00 P. M. Vibration**
>
> S. J. ZAND, *Chairman*
>
> Measurement of Vibration in Flight – C. S. DRAPER and G. P. BENTLEY, *Massachusetts Institute of Technology*, and H. H. WILLIS, *Sperry Gyroscope Co.*
>
> The Vibration Problems in Propeller Designing – F. W. CALDWELL, *Hamilton Standard Propeller Co.*
>
> ### Friday, March 12
>
> **10.00 A. M. Aerodynamic Problems**
>
> PETER ALTMAN, *Chairman*
>
> Laminar and Turbulent Boundary Layers as Affecting Practical Aerodynamics – E. N. JACOBS, *National Advisory Committee for Aeronautics*
>
> The Practical Application of Fowler Flaps – H. D. FOWLER, *Glenn L. Martin Co.*
>
> **10.00 A. M. Engines**
>
> ROBERT INSLEY, *Chairman*
>
> Carburetion of Engines for Long Range Flight – W. L. LOSSON, *Wright Aeronautical Corp.*

Growing Fear of Automobile Accidents Declared Threat to Industry's Progress

• Indiana

"The automotive industry should awake to the fact that traffic congestion in cities and suburban centers (due to lack of proper traffic control), and the fear of accidents on long trips is already seriously cutting down the use of automobiles and their sale. Unless the industry does something about this soon the future progress and growth of the industry will be disastrously affected," said Burton W. Marsh, American Automobile Association, in opening his talk, "Building Better Drivers," before the Indiana Section, Feb. 11.

"In spite of our tragic growth in the accident rate last year the picture is not all black," continued the author. He added that during 1936 nearly half the states reduced their accident rate and 146 cities (more than half of those that reported with complete data) succeeded in reducing the fatality rate for the year. It is evident, he said, that any city or state that really desires to reduce accidents can do it, if it is willing to pay the price. Statistics, he stated, seem to prove that the city or state that heretofore has pleaded 'unusual conditions make it impossible to save life' does not have a leg to stand upon." Mr. Marsh declared, "the toll can be reduced. It is being substantially reduced in all types of communities that employ modern and adequate prevention methods. No one thing will perform the miracle we desire. We must use every method and in some way control driver attitude and ability which seems to be one of the key troubles in the mounting accident and fatality rate. There must be control and education of many sorts. Our police must handle this part of the problem and correct drivers as well as arrest them and prosecute.

"We must awake to the fact that we are confronted with the problem of handling a gigantic transportation system that demands better facilities. We must realize that we need not only train drivers to better driving but train our police officials to better methods and better understanding of traffic and its shortcomings. The AAA is undertaking the training of the 18 to 22-year olds who at present have a higher accident rate than is necessary." That adult education must also be undertaken somehow was agreed to by the speaker in answer to questions brought out in the discussion.

Lee Oldfield, John T. Whitaker and Wilbur Shaw brought out two viewpoints on speed in the discussion. Mistaking the speaker's use of the term "speed and road control" to mean that low speed limits be established, both Mr. Oldfield and Mr. Whitaker took the ground that slow traffic, indolent turning into main roads, slow-poke drivers and those who turn from one lane to another into oncoming traffic without looking, are dangers most frequently met on the highway.

Mr. Shaw said "Forty-five is fast enough for road speeds. I am in greater fear of accidents every time I drive across the country than in facing the 500-mile race. When we bowl along the road at top speed and see a slow sign we drift along at what seems a creeping pace to us. Actually we are going at a high rate as we find out when we meet an unknown 45 deg. turn or some other frequently met accident situation. High speed on the road is a lot more dangerous than wide-open flight on a race track. We might as well recognize this fact and adjust ourselves to it."

Bigger Airplanes to Come, Declares Wilson

• So. New England

"The whole trend nowadays is toward bigger airplanes," declared Chairman Eugene E. Wilson in opening the Jan. 20 meeting of the Southern New England Section which was attended by 120 members and guests. "We don't know," he continued, "what is the biggest possible plane. We have found that the bigger they are, the easier they are to build and the bigger they are, the more economical they are."

Igor I. Sikorsky, scheduled to address the meeting, was prevented by illness from attending. In his place A. V. D. Willgoos, engineering manager of Pratt & Whitney Aircraft, gave a descriptive talk on the two-row radial engine, presenting with it numerous slides and colored motion pictures of a cut-away engine in operation.

Salient points made by Mr. Willgoos include the following:

Pan-American regularly develops fuel economies of 0.43 lb. per hp-hr. on the trans-Pacific run.

Experimental test-stand economies of 0.38 lb. per hp-hr. have frequently been made and occasionally bettered, which leads one to question the value of aircraft Diesels.

Wasp "H" engines now run 600 hr. between overhauls on United Airlines, without even valve adjustment.

Exhaust valves have run 3000 hr. of airline service without apparent harm from fatigue or other cause.

Impeller-blade-tip speeds of 900 ft. per sec. and master-rod bearing pressures of 35,000 lb. per sq. in. are now in use.

An automatic delayed-action oil-relief valve is now used on P & W engines, giving momentary oil pressures of 250 lb. per sq. in., for starting, which drop off to normal values as the engine begins to run.

Reports Temperature of 70 Below at 35,000 Ft.

• Kansas City

The temperature drops as low as 70 deg. below zero when you are flying at 35,000 ft., D. W. Tomlinson, assistant to the vice-president, Transcontinental & Western Air, Inc., told 89 members and guests of the Kansas City Section, Jan. 19, in recounting some of his personal experiences in sub-stratosphere flight. With him on the program was Kendell Perkins, assistant

Aeronautic Meeting

The Design of Metal Fins for Air-Cooled Engines – A. E. Biermann, ***National Advisory Committee for Aeronautics***

Aircraft Engine Reduction Gears – Ford L. Prescott, ***U. S. Army Air Corps.***

2.00 P. M. Aircraft Design

H. J. E. Reid, ***Chairman***

Interior Finish of Transport Airplanes – H. O. West, ***United Air Lines***

Propeller Design Trends in France* – H. L. Brownback

Design Trends as Affecting Ground Facilities* – L. L. Odell, ***Pan American Airways***

***Under the sponsorship of the Aeronautics Division of the A.S.M.E.*

2.00 P. M. Engines

Val Cronstedt, ***Chairman***

Flexible Exhaust Valve Seats – S. D. Heron, ***Ethyl Gasoline Corp. and*** **A. L. Beall,** ***Wright Aeronautical Corp.***

Determination of Service Ratings for Aircraft Engines – R. F. Gagg, ***Wright Aeronautical Corp.***

Lubrication and Cooling Systems for Aircraft Engines – Weldon Worth, ***U. S. Army Air Corps***

6.30 P. M. Banquet

Speakers

Lieut. Col. B. O. Lewis, Chairman, Washington Section

C. H. Chatfield, Toastmaster

Harry T. Woolson, SAE President

Arthur Nutt, ***Wright Aeronautical Corp.*** **EUROPEAN AVIATION ENGINES**

chief engineer, Curtiss-Wright Airplane Corp., St. Louis division, whose subject was "The Sub-Stratosphere Transport Airplane." Mr. Perkins substituted for G. A. Page, chief engineer of the same company, who was ill at that time.

Continuing Mr. Tomlinson told of winds encountered at the base of the sub-stratosphere. At one time, he said, the wind from the north reached 100 m.p.h., and in another instance he drifted about 80 miles in 20 min. He made the interesting comment that he photographed the instruments because there was not time to record their readings quickly enough to have them accurate for a given condition. The readings were later taken from the photographs.

At Mr. Tomlinson's request no notes were taken of the technical portions of his paper. Mr. Perkins likewise requested that his remarks not be printed.

Ralph R. Matthews told what happened at the Annual Meeting of the Society. E. F. Lowe, SAE assistant general manager, spoke of the nation-wide work of the Society and brought greetings from General Manager John A. C. Warner. E. W. Pughe, chairman of the Section, introduced the speakers and outlined meeting plans for the remainder of the year.

Method of Determining Octane Numbers Studied

● Washington

What is the proper method of determining octane numbers? Why cannot specifications for hypoid-gear lubricants be established? When should crankcase oil be changed? These were some of the questions answered – or at least commented on far into the night at the Feb. 9 meeting of the Washington Section. About 120 members and guests heard Dr. T. G. Delbridge, research and development manager, Atlantic Refining Co., speak on "Petroleum Products for Automotive Service."

At the business session Section members decided that they do not favor legislation requiring the registration of "professional" engineers in the District of Columbia, and heard J. F. Fox, as chairman of the Section Membership Committee, offer a prize of a Society pin to any member not on the committee, who brought in two new members for the Section and Society.

The present A.S.T.M. method of determining octane numbers favors some refineries but is hard on others, Dr. Delbridge indicated. He hoped that efforts to find a single method would be right, but thinks they are wrong. A given fuel, he said, might show certain antiknock properties in the laboratory, but act quite differently on the road. Dr. H. C. Dickinson held that the problem can not be solved, and that a certain amount of approximation must be accepted.

Specifications for hypoid lubricants can not be written, at present, Dr. Delbridge declared after the need for them had been suggested by F. M. McGeary, because their application is still in the experimental stage. His company is not prepared to accept responsibility for performance, unless the gears are in reasonably good condition. He warned that trouble might develop if hypoid lubricants made by different companies are mixed. The non-petroleum substances might react to form sludge or cause other difficulty, he said. C. M. Larson outlined the problems arising with hypoid applications and agreed that there is a lot to be learned about them.

Crankcase oil in passenger-car engines should be changed at 1000-mile intervals in summer and each 500 miles in winter, Dr. Delbridge believes. In the winter when the car is not used much, it is good insurance to make the change once a month, he said. Experience with a large fleet of trucks in bakery service was described in discussion submitted by I. H. Bernhardt, and read by B. H. Lemon. This fleet has covered about seventeen million miles in four years, with filters installed by the operating company; without draining the oil, although countless tests have been made of oil samples and the condition of the engine has been carefully checked.

Also participating in the discussion were A. W. S. Herrington, Walter Bauer, C. E. Earle, and Lt. S. G. Nordlinger. Dr. O. C. Bridgeman acted as sponsor and presided at the technical session.

"Wear – What It Is" Told by Metallurgist

● Baltimore

"Hardness of metals is not a measure of wear . . . Cast iron is better than steel due to its self-lubricating qualities . . . Graphite in grain boundaries of cast iron supports particles which resist wear . . . Wear is less on metals if machined in the direction contacting metal; engine cylinders should be honed from top to bottom by a vertical motion, rather than by machining concentric." These are but a few statements taken from Paul S. Lane's paper, "Wear, What It Is," read by him before the Feb. 4 meeting of the Baltimore Section.

Mr. Lane, who is metallurgical research engineer, American Hammered Piston Ring Co., and secretary of the American Society for Metals, was heard by some 90 members and guests as he cleared up many popular misconceptions regarding wear of metals.

Heldt Traces Automatic Transmissions to 1900

● Philadelphia

Speaking before the largest audience assembled for a Philadelphia Section meeting this season, P. M. Heldt, engineering editor, *Automotive Industries,* read a veritable encyclopedia of automatic-automotive-transmission information on Feb. 10.

Automatic transmissions are not a new development, he said, noting that the Sturtevant car which was placed on the American market as early as 1904 was so equipped and that in

At Chicago Section's February Meeting

Courtesy Photo-Chek Service

O. D. Treiber, of Hercules Motors Corp., ***at the left,*** **gave the Chicago Section the lowdown on Automotive Diesel Engines, Feb. 2. With him at the speakers' table are,** ***from left,*** **Fred L. Faulkner of Armour & Co., Chicago's chairman; W. A. Parrish, Buda Co.; Leonard B. Gilbert, White Motor Co., and William A. Sears, Lane Technical School.** ***(See story on following page.)***

1900, George S. Strong of New York had developed such a mechanism. Mr. Heldt went on to say that by 1910 all American cars with the exception of the Model T Ford had adopted sliding gear transmissions, a European development that met with many objections when first marketed.

Not much progress was made during the second and third decades of the present century, according to Mr. Heldt, but in the late twenties the Warner Gear Co., introduced its Hi-Flex transmission and this development definitely focused attention upon the transmission problem.

The author went on to describe in detail the Strong reversible roller ratchet transmission, the de Lavaud swashplate and roller ratchet type, the R.v.R. automatic torque converter and the Waterbury hydrostatic torque converter. Other transmissions described in detail were the Lysholm-Smith, several inertia type transmissions, and the Mono-Drive (Banker) transmission used by Yellow Coach, which is the only transmission now being used as standard equipment. Following were descriptions of the Macallen torque balancing mechanism and self-shifting transmission, the Prince self-shifting transmission, the Entz electric, the Electrogear unit and the Bendix Turbo Flywheel gear.

B. B. Bachman, Autocar Co., was the meeting chairman and the discussion was led by Oscar H. Banker, vice-president, New Products Co., and D. C. Prince, chief engineer, Philadelphia works, General Electric Co., both of whom had transmissions under discussion. Maurice Partiot, Fleishel Control System, Paris, France, described the research and results of the Fleishel Control applied to the Cotal transmission. Preceding the technical session was a brief account of the Spanish War situation by H. C. Plummer, an American correspondent, and some comments of the automotive aspects of the conflict by Jose Pedroso, an Insurgent transport officer.

When Donald Blanchard left Philadelphia to become secretary of the SAE Engineering Relations Committee in New York he left vacant the office of vice-chairman of the Philadelphia Section. Chairman L. M. DeTurk has filled this office by moving Secretary D. D. Robertson to vice-chairman, Treasurer Frederick L. Creager to secretary, and by appointing Henry Jennings as the new treasurer.

Says 25,000 Miles per Year Warrants Use of Diesels in Transport Service

• Chicago

Present-day automotive-type Diesel engines are generally applicable in highway-transport service ranging more than 25,000 miles per year, said O. D. Treiber, chief engineer, Diesel division, Hercules Motors Corp., Feb. 2, in addressing the largest regular monthly meeting in the history of the Chicago Section. More than 300 guests and members were present.

Speaking particularly of the Hercules model DJX series Diesel, Mr. Treiber said that objectionable odors are largely eliminated through a combustion-chamber construction which effects a high degree of uniformity in the burning of fuel oil. He also declared that troubles from cold-weather operation are no obstacle to Diesel operation, calling attention to a fleet of Diesel-powered trucks operating in a section of Canada where the temperature dips to 35 deg. below zero. Heating of water and oil are sometimes desirable under these conditions, he added.

Many slides and a cut-a-way engine aided the author in describing the operation of the Hercules model DJX series of Diesels, defined as the four-cycle internal-combustion compression-ignition injection type. He explained that to provide effective turbulence of air in the combustion chamber as fuel is injected, and thus to secure thorough mixing, the engine has its combustion-chamber opening on the side of the cylinder. This, he said, results in more complete combustion, providing maximum power with minimum fuel consumption, smoke and noise. Continuing he pointed out that as air velocity would tend to slow up due to reducing piston speed, the piston begins to cover the chamber opening so that the velocity is steadily increased until the piston is about 12 deg. ahead of top center. By then, he said, the air revolves inside the combustion chamber from 40 to 50 times the crankshaft speed so that the injection of the finely atomized fuel mist into the rapidly moving air insures a more complete mixing of air and fuel than can be obtained by any other known method.

In discussing fuel oil Mr. Treiber pointed out that neither gravity, viscosity nor color indicate ignitibility, with this exception: low viscosity (about 35 sec. Saybolt Universal) and low Baumé (about 20 deg.) are indicative of a hard fuel oil to burn. He listed characteristics to guide in selecting a neutral-distillate-petroleum fuel, shown in table below.

Accelerative ability of the Diesel, freedom from carbon deposits, and a carbon-monoxide content of less than 0.005 per cent in the exhaust gases, he pointed out, are among features which commend Diesel engines for use in highway transport service.

D. S. Craven, service manager of the Cummins Engine Co., in a prepared comment on maintenance of Diesel trucks, declared that any abnormal troubles reported on replacement installations are usually found to be due to lack of balance between the axle, transmission, clutch and the new powerplant. Properly balanced installations, he stressed, should incur no greater maintenance expense than gasoline units. Modern trucks designed throughout as a Diesel unit, he asserted, are free from earlier deficiencies and more adapted to operation on a comparable basis with gasoline trucks and with special advantage as to fuel economy.

In the discussion questions were replied to by Mr. Treiber, dealing with wet vs. dry liners, comparative operating costs of gas trucks and Diesel trucks, fuel pumps and spray nozzles. The life of a fuel injection pump, one operator declared, has been shown by tests to be indefinite, if the fuel entering pump is clean. Adjustment of spray nozzles can be readily handled by the operator, Mr. Treiber stated, adding that where necessary, special equipment is available for the purpose. W. W. Parrish, chief engineer, of the Buda Co., serving as chairman of the technical session, introduced the speaker.

Characteristics listed by O. D. Treiber in a Chicago Section talk as a guide in selecting a neutral-distillate-petroleum fuel for Diesel engines are:

1. Viscosity at 100 deg. fahr.	Minimum	35 sec.
(Saybolt Universal) (Preferably 40 to 70)	Maximum	100 sec.
2. Sulphur (by weight)	Maximum	2.0 per cent.
3. Conradson Carbon	Maximum	0.2 per cent
4. Ash Content	Maximum	0.02 per cent
5. Moisture and sediment (BS&W) (per cent by vol.)	Maximum	0.05 per cent
6. Flash (for insurance purpose only)	Minimum	150 deg. fahr.
7. Pour at least 10 deg. less than lowest temperature where engine operates.		
8. Ignition and burning qualities to be equal to: No. 1-D.		
Cetane number, min.		50
Diesel Index number, min.		45
Viscosity-gravity number, max.		0.86
Boiling point-gravity number, max.		188

Two Types of Automatic Transmission Explained

• Metropolitan

Successful operation of two different types of automatic transmission – one on Chicago buses and another on French passenger cars – was reported at the Automatic Transmission Meeting of the Metropolitan Section, Feb. 8. A third paper on "finger-tip" control or automatic shifting completed the program arranged by Harold F. Blanchard, technical editor, *Motor*. T. C. Smith was chairman. Attendance totaled 175.

"The chief unit of interest on the drawing board, in the laboratory, on the road, and on the proving ground is an improved form of transmission," contends Austin M. Wolf, consulting engineer, in the first part of his paper, "Automatic Transmissions" and sub-titled "The Cavalcade of the Transmission." Classifying the various types of automatic transmission he stated, "It would appear that the addition of a manual control that can assert itself over an automatic control would be desirable as many operators wish full control rather than to relegate it to a robot." Mr. Wolf concluded the first part of his paper with a review of developments in the transmission field from 1904 to the present.

In the second part, Mr. Wolf related the experience record of 101 new coaches of the Chicago Motor Coach Co., each equipped with "Mono-Drive" or Banker automatic transmission, during six months of operation covering over 2,000,000 miles. Important results claimed by Mr. Wolf for this transmission are decreased driver fatigue by the elimination of thousands of gear shifts and de-clutchings during the day's work, smoother operation, and reduced number of accidents. "During this period," he reported, "not a single universal joint, drive shaft, or axle shaft has been broken due to shock loads." The Mono-Drive consists of a planetary type of transmission mechanism with three speeds forward and one reverse and with automatic control, Mr. Wolf explained, showing how it employs centrifugal force through governor weights to shift gears automatically when the throttle is closed at certain speeds.

The Fleischel-Cotal Automatic transmission as used on Peugeot cars in France was championed by Maurice Partiot of Paris, in his paper, "Automatic Transmissions – Here and

(Continued on page 27)

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Jan. 10, 1936, and Feb. 10, 1937.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Allan, Gordon G. (A) associate editor, Motor Magazine (Hearst Publications, Inc.), 572 Madison Ave., New York City; (mail) 1660 Nelson Ave.

Batten, John Henry III (J) student, Twin Disc Clutch Co., Racine, Wis.

Beck, Joseph F. (J) tool & die maker, Ford Motor Co., Dearborn, Mich.; (mail) 8600 Northlawn, Detroit, Mich.

Butler, Charles W. (M) assistant engineer, Gulf Research & Development Co., P. O. Box 2038, Pittsburgh, Pa.

Chess, Gerald E. (J) engineer, San Joaquin Light & Power Corp., Fresno, Calif.; (mail) 820 Peralta Way.

Claffey, Bernard D. (A) manager, gray iron & aluminum divisions, General Malleable Corp., Waukesha, Wis.

Clark, C. A. (A) maintenance electrician, Briggs Mfg. Co., Hamtramck, Mich.; (mail) Room 438, N.E. Y.M.C.A., 10100 Harper Ave., Detroit, Mich.

Cunnington, George R. (M) acoustical engineer, Woodall Industries, Inc., 7565 E. McNichols Rd., Detroit, Mich.

Damon, Ralph Shepard (M) vice-president, American Airlines, Inc., 4848 W. 63rd St., Chicago, Ill.

Desmond, John V. (J) production engineer, B. G. Corp., 136 W. 52nd St., New York City; (mail) 365 Washington St., Perth Amboy, N. J.

Doubet, Frank (A) regional manager, General Motors Truck Co., 180 N. Michigan, Room 1506, Chicago, Ill.

Duckworth, John B. (J) engineer, engine laboratory, Standard Oil Co. (Ind.), Whiting, Ind.; (mail) 1537—119th St.

Duus, H. C. (M) chemist, E. I. duPont de Nemours & Co., Exper. Station, Ammonia Dept., Wilmington, Del.

Eacker, Earl H. (M) assistant to vice-president, engineer of district, Boston Consolidated Gas Co., 100 Arlington St., Boston, Mass.

Enright, William C. (M) sales engineer, Western Felt Works, 420 Stephenson Bldg., Detroit, Mich.

Faber, Albert Frank, Jr. (J) observer in test, Wright Aeronautical Corp., Paterson, N. J.; (mail) 112 Rutland Rd., Brooklyn, N. Y.

Fix, Fred (A) salesman, Johns-Manville Sales Corp., 1530 Builders Exchange, Cleveland, Ohio.

France, Charles W. (M) vice-president, general manager, Curtiss-Wright Corp., Robertson, Mo.

Goldstein, Harry D. (J) Naval Aircraft Factory, Philadelphia, Pa.; (mail) 3909 Pine Street.

Greer, Edward M. (J) draftsman, research department, Continental Motor Corp., Detroit, Mich.; (mail) 4052 Tyler.

Hall, Charles Louis (J) engineering aide, U. S. Army, Air Corps, Wright Field, Dayton, Ohio; (mail) 1621 Grand Ave.

Harris, Benjamin F. III (A) industrial designer, 224 S. Michigan Ave., Chicago, Ill.

Higgins, John S. (M) president, treasurer, general manager, Whittet-Higgins Co., 92 Niagara St., Providence, R. I.

Hopkins, Ben F. (M) president, Cleveland Graphite Bronze Co., 880 E. 72nd St., Cleveland, Ohio.

Hutton, Richard (J) project engineer, Grumman Aircraft Engine Corp., Farmingdale, L. I., N. Y.; (mail) 8946—97th St., Woodhaven, L. I., N. Y.

Johnson, Ralph Samuel (M) test pilot, assistant test engineer, United Air Lines Transport Corp., Cheyenne, Wyo.

Kawara, Masaki (FM) factory manager, Teikoku Spring Co., Ltd., Terajima-cho, Mukojimaku, Tokyo, Japan.

Kelley, Theron R. (M) Diesel field engineer, Waukesha Motor Co., Waukesha, Wis.; (mail) 708 Cumberland Drive.

Kolbe, Harold O. (A) factory manager, Canadian Motor Lamp Co., Ltd., Windsor, Ontario, Canada.

MacClure, A. C. (M) time study supervisor, Hudson Motor Car Co., 12601 E. Jefferson Ave., Detroit, Mich.; (mail) 2659 Lakewood Ave.

Mauck, Pierre J. (M) chief engineer, Fisher Body Corp., General Motors Bldg., Detroit, Mich.

McKay, Edward W. (A) sales engineer, Bendix-Westinghouse Automotive Air Brake Co., 5001 Centre Ave., Pittsburgh, Pa.

Melhado, Donald (A) president, Sunair Auto Top Co., Inc., Room 1404, 341 Madison Ave., New York City.

Miller, Charles H. (A) assistant representative, service manager, White Motor Co., Cleveland, Ohio; (mail) 1552 Ansel Rd.

Morris, William H. (J) chief clerk, Sinclair Wyoming Oil Co., Drawer B, Bairoil, Wyo.

Mulhern, William A. (M) assistant chief chassis engineer, Chrysler Motor Corp., Engrg. Bldg., Oakland Ave., Highland Park, Mich.; (mail) 14567 Woodmont Rd., Detroit, Mich.

Newton, Thomas J. (J) assistant supervisor, test fleet, U. S. Rubber Products, Inc., 6600 E. Jefferson Ave., Detroit, Mich.; (mail) 2014 Elizabeth, Kansas City, Kans.

Nourse, Hugh C. (M) vehicles engineer, Bell Telephone Co. of Canada, Montreal, Quebec, Canada.

Oliver, Alfred Frank (A) sales & service manager, Electric Auto-Lite, Ltd., Sarnia, Ontario, Canada.

Parsons, Henry C. (J) draftsman, Parsons Co., Detroit, Mich.; (mail) 947 Berkshire Rd.

Pioch, Wm. F. (M) chief draftsman, Ford Motor Co., Rouge Plant, Dearborn, Mich.; (mail) 3529 Sherbourne Rd., Detroit, Mich.

Priest, Harry T. (J) secretary, P. K. Priest, Inc., 120 E. Superior St., Duluth, Minn.

Priestley, Samuel Albert G. (J) refinery chemist, Shell Co. of Australia, Ltd., Clyde Refinery, Unwin St., Clyde, New South Wales, Australia; (mail) Pitsmoor, The Grove, Roseville, New South Wales, Australia.

Rainey, Rexton S. (M) engineer, Victor Mfg. & Gasket Co., 5750 Roosevelt Rd., Chicago, Ill.

Roth, George Lewis (J) assistant chief engineer, Franklin Valveless Engine Co., Franklin, Pa.

Shapiro, Francis Peter (J) salesman, General Automotive Electric Co., 239 E. 149th St., New York City.

Shumway, Alfred E. (A) manufacturing agent, 647 W. Virginia St., Milwaukee, Wis.

Smith, Earl W. (A) vice-president, Dixie Greyhound Lines, Inc., 146 Union Ave., Memphis, Tenn.; (mail) 226 Washington Ave.

Smith, Laurie C. (M) designer, Atlas Imperial Diesel Engine Co., Oakland, Calif.; (mail) 2119 Foothill Blvd.

Sommers, Alex. C. (M) engineer, Richfield Oil Corp. of N. Y., 19 W. 50th St., New York City.

Souliere, Ernest A. (A) sales manager, Canadian Motor Lamp Co., Ltd., Windsor, Ontario, Canada.

Squiers, John C. (J) airplane designer, Barkley-Grow Aircraft Corp., 13210 French Rd., Detroit, Mich.; (mail) 648 Lawrence Ave.

Stahl, Andrew T. (M) testing engineer, Mack Mfg. Corp., Plainfield, N. J.; (mail) 235 Willow Ave. Extension, North Plainfield, N. J.

Stevens, Arthur W. (A) research, 901 India Bldg., 84 State St., Boston, Mass.

Stewart, S. Floyd (M) engineer, Leece Neville Co., 5363 Hamilton Ave., Cleveland, Ohio; (mail) 2413 Woodmere Drive.

Stratton, C. Malcolm (J) sales department, Texas Co., Statler Bldg., Boston, Mass.; (mail) 158 Central St., Auburndale, Mass.

Talbert, John E. (J) engineer, Wright Aeronautical Corp., Paterson, N. J.; (mail) 41 Lewis St.

Thorpe, Leslie R. (A) salesman, International Harvester Co., 611 W. Roosevelt Rd., Chicago, Ill.; (mail) 4350 N. Lincoln St.

Vallier, Archibald E., Jr. (J) field representative, Ethyl Gasoline Corp., North Kansas City, Mo.; (mail) 2512 N. 51st Ave., Omaha, Nebr.

Van Hiel, Bryn Jhan (A) industrial division engineer, Lycoming Mfg. Co., Industrial Engine Div., 3443 Wilshire Blvd., Los Angeles, Calif.; (mail) 2624 Glendale Blvd.

von Goler, Friedrich Karl, Dr. (FM) scientific collaborator, Metallgesellschaft A.G., Bockenheimer Anl. 45, Frankfurt a.M, Germany.

Wacker, C. W. (A) National Account Sales, B. F. Goodrich Co., 310 W. Taylor St., Chicago, Ill.

Westlake, Vincent F. (J) Westlake Brothers Ice & Coal, Fords, N. J.; (mail) 147 Ford Ave.

Wydler, John J., Dr. (M) development engineer, Doherty Research Co., 60 Wall St., New York City; (mail) 47 Maryland Ave., Long Beach, L. I., N. Y.

Young, Melvin H. (J) engineer, Wright Aeronautical Corp., Lewis St., Paterson, N. J.; (mail) 328-B Plaza Rd., Radburn, N. J.

Applications Received

The applications for membership received between Jan. 15, 1936, and Feb. 15, 1937, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Allen, Everett Wait, coach engineer, Yellow Truck & Coach Mfg. Co., Pontiac, Mich.

Almond, John Raymond, experimental engineer, Midland Steel Products Co., Cleveland, O.

Banta, Clifford, petroleum technologist, E. I. duPont de Nemours & Co., Inc., Wilmington, Del.

Bauman, John Nevin, vice-president, The White Motor Co., Cleveland, O.

Beaver, Karl, research engineer, Ethyl Gasoline Corp., Detroit, Mich.

Beddow, Victor John, electrical engineer,

Southdown Motor Services, Ltd., Sussex, England.

BISSELL, T. A., technical editor, Society of Automotive Engineers Journal, New York City.

BLACKIE, RONALD H., factory manager, American Bantam Car Co., Butler, Pa.

BOLLES, JAMES C., sales manager, National Automotive Fibres Corp., Detroit, Mich.

BORRANI, CARLOS, general manager, Rudge Whitworth Societa Italiana, Milano, Italy.

BRISSON, LOUIS CHARLES, chief engineer, Societe des Freins Hydrauliques S de Lavaud, Paris, France.

BURCHELL, M. J., designing engineer, DeLuxe Products Corp., LaPorte, Ind.

CARLSON, WILLIAM H., sales representative, Twin Coach Co., New York City.

CARTER, GEORGE A., sales engineer, Allen Electric & Equipment Co., Kalamazoo, Mich.

CHAPIN, EDWARD ALBERT, test engineer, research department, Continental Motors Corp., Detroit, Mich.

DAVIDS, WILLIAM C., associate marine engineer, U. S. Navy, New York Navy Yard, Brooklyn, N. Y.

DAVIES, CLARENCE E., secretary, The American Society of Mechanical Engineers, New York City.

DILLON, H. G., sales engineer, New Departure Mfg. Co., Pittsburgh, Pa.

DRESCHER, THEODORE A., manager of transportation, Borden's Farm Products, New York City.

DUNNING, CHARLES L., service manager, White Motor Co., Pittsburgh, Pa.

EGGLESTON, HERBERT L., manager gas and refining departments, Gilmore Oil Co., Los Angeles, Calif.

FIELD, JOHN TRUMAN, Diesel sales, Kenworth Motor Truck Corp., Seattle, Wash.

FISH, JOHN ROBERT, Research & Engineering Co., Springfield, Mass.

FLOOD, HENRY, JR., executive vice-president, Devonshire Corp., New York City.

GARTON, FRANK LESLIE, associate director, motor testing laboratory, Shell Petroleum Corp., St. Louis, Mo.

GIBSON, GEORGE FRANCIS, experimental engineer, Vauxhall Motors, Luton, England.

GILKESON, NOBLE D., service manager, Hudson Brace Motor Co., Kansas City, Mo.

GUNN, JAMES, motor vehicle inspector, Public Utilities Commission, Los Angeles, Calif.

HOLDER, ALFRED ROGER, mechanic, White Motor Co., Toronto, Ont., Canada.

HORIAK, ERWIN A. V., research engineer, Hercules Motors Corp., Canton, O.

IMBLUM, ALLEN JOHN, vice-president, Pittsburgh Auto Spring Co., Pittsburgh, Pa.

INGALLS, DAVID BAGBY, engineer, Titeflex Metal Hose Co., Newark, N. J.

JERROLD, GILBERT, ingenieur, French Government, Paris, France.

KESSLER, J. R., Roberts Motor Co., Portland, Oregon.

LABORY, R. F., automotive department clerk, Union Oil Co. of California, Los Angeles, Calif.

LAFAYE, H. J., sales, Rim Division, Goodyear Tire & Rubber Co., Inc., Akron, O.

LANG, WALTER GORDON, service representative, General Motors – Holden's Ltd., Melbourne, Victoria, Australia.

LEWIS, LEWIS DAVID, production manager, E. G. Eager & Son, Ltd., Brisbane, Queensland, Australia.

LOGATCHEFF, ALEXANDER, cenetechnician, Paramount Pictures, Inc., Hollywood, Calif.

LOVELL, HALTON A., manager, Snap-On-Tools of Canada Ltd., Toronto, Ont., Canada.

MAGNUSON, CARL J., electrician, Fields Motor Car Co., Portland, Oregon.

MANVILLE, WILLIAM WINDECK, student, Rensselaer Polytechnic Institute, Troy, N. Y.

MARSHALL, JOHN MACINTOSH, vice-president, Valvoline Oil Co., Cincinnati, O.

MAUN, DONALD D., automotive engineer, Lubri-Zol Corp., Wickliff, Ohio.

MCCLELLAND, EDWARD W., sales representative, Shakeproof Lock Washer Co., Chicago, Ill.

MCCOY, JOHN T., general supervisor, research and development, Tide Water Associated Oil Co., Bayonne, N. J.

MILLY, AVY, sales engineer, Frazier-Wright Co., Los Angeles, Calif.

MINAKER, HARRY LEWIS, mechanic, Packard Ontario Motors, Toronto, Ont., Canada.

MORRIS, HAROLD L., chief engineer, Hall Scott Motor Car Co., Berkeley, Calif.

MOUTIER, FIRMIN L., service manager, Cadillac Motor Car Co., New York City.

NUNNENKAMP, WILLIAM, service manager, Fields Motor Car Co., Portland, Oregon.

RAYMOND, ARTHUR E., vice-president, engineering, Douglas Aircraft Co., Santa Monica, Calif.

REUTHER, MARTIN ERNST, draftsman, Fisher Body Engineering, Detroit, Mich.

ROBINSON, SAMUEL T., field engineer, Wright Aeronautical Corp., Paterson, N. J.

RONAN, ARTHUR T., president, T. J. Ronan Co., New York City.

ROTH, WILLIAM HARRISON, service representative, General Motors Sales Corp., Philadelphia, Pa.

ROZETT, BENJAMIN, superintendent, United Standard Products, Inc., Chicago, Ill.

SCHOOLEY, RALPH E., mechanical engineer, American LaFrance Foamite Corp., Elmira, N. Y.

SCHUTZ, TED, field engineer, Allen Electric & Equipment Co., Kalamazoo, Mich.

SLOANE, ROBERT WOODARD, engineering, Monarch Governor Co., Detroit, Mich.

SMITH, CARLSON W., president, Consolidated Coal & Coke Co., Denver, Colo.

STANTON, GEORGE TAYLOR, manager, technical consulting, Electrical Research Products, Inc., New York City.

UPP, GEORGE WILLIS, designer, Midland Steel Products Co., Cleveland, O.

WEASLER, ANTHONY V., manager, Pick Manufacturing Co., West Bend, Wis.

WHITE, HAYDN JAMES, delivery superintendent, Gulf Oil Corp., Philadelphia, Pa.

YERZLEY, FELIX L., physicist, E. I. duPont de Nemours & Co., Wilmington, Del.

ZUERL, DONALD, draftsman, A. B. Chance Co., Centralia, Mo.

1937 Handbook Has 39 Revisions, New Standards

March is scheduled to bring SAE members their copies of the 1937 SAE HANDBOOK. This edition, now on the press, includes 39 new or revised standards approved by the General Standards Committee at its last meeting and adopted by the Council. These are vital changes and it is important that the new HANDBOOK replace the 1936 edition on the desk of each SAE member.

Among the major revisions included are specifications for aircraft-engine propeller hubs and shaft ends, flexible steel conduit and tubing, fuses and fuse clips, V-belts and pulleys, electric-lamp bulbs and bases, sockets, plugs and connectors and zinc alloys for die casting. Likewise important are the revised Lighting Division specifications for tail lamps and electric signal lamps and for minimum laboratory acceptance requirements for automobile headlamps.

All of the new specifications are valuable contributions to the industry. One on insert valve seats is the culmination of some three years of work on this vital subject. A new specification on glass is an important piece of work. The tractor testing code is the first big job completed by the Tractor and Equipment Division.

Other new standards include specifications for tractor magneto mounting, new recommended practices for emergency electric lanterns for vehicles stalled at night; clearance, marker and identification lamps, and a code for inspection and adjustment of headlamps of motor-vehicles in use.

1937 SAE Roster Includes 2058 Changes

All dressed up in its new cover the 1937 SAE ROSTER is now in the hands of most members. Including the names of all those who joined the Society during 1936 it also has 2058 changes requested by old members who have had promotions, new jobs or new addresses.

The total number of names is 5645. Geographically speaking it includes listings from every state in the Union and from 39 foreign countries.

Besides the names, positions and addresses of SAE members it also includes officers and council members of the Society, Section officers, committee personnel, past-presidents, SAE representatives on other organizations, members associated with universities and schools, enrolled students, companies with which members are associated and membership statistics. Information on membership, a price schedule of SAE publications and a description of the official SAE emblem are also included.

Production Work Stirs New Membership Interest

Membership prospects among manufacturing men have already been stimulated materially by the new work in promotion of SAE Production activities being done by O. B. Zimmerman under a special grant, SAE Production Vice-President R. R. Keith announces.

Confining his current efforts to the Middle West where an overwhelming proportion of automotive manufacturing is located, Mr. Zimmerman is visiting scores of plants in the Milwaukee, Chicago and Detroit areas, and has already developed valuable data on topics which practical production men want to hear discussed at SAE meetings. This information is being correlated for study by the Production Activity Committee, Mr. Keith states, and will be utilized in developing more vital meetings to attract a wider range of manufacturing membership than has heretofore been possible.

Four New Projects to SAE Standards Committee

Since the first of the year the SAE Standards Committee has scheduled four new projects for standardization and revisions of two existing standards. The new subjects are ratings for electrical equipment, engine and chassis number locations, anti-freeze solutions and tap drills. Standards to be revised are those for fuel-pump mountings and leaf springs.

Independent Committee Studies Cutting Fluids

An independent Research Committee on Cutting Fluids was formed during the past year for the purpose of investigation in the field of standardization and utilization of cutting fluids. It has a personnel of 18 members, made up of automotive metallurgists and cutting oil engineers. The chairman of this committee is Joseph Geschelin, Detroit technical editor, *Automotive Industries*. Two technical projects are now being investigated by subcommittees, and formal reports will be available in the very near future.

News of the Society

(*Continued from page 24*)

Abroad." Two requirements of the automatic transmission, according to Mr. Partiot, are that it must do what the driver wishes to do within a fraction of a second from the driver's decision and that it should not shift when the driver does not want it to shift. The Fleischel-Cotal transmission he classified as an indirect-control transmission – "in which a mechanical brain decides the timing of the shifting and in which a booster, borrowing power from the motor, accomplishes the gear shifting when it receives the impulses from the control." Mr. Partiot then explained the operation of the control that depends upon both speed and throttle and of the Cotal magnetic planetary gear box, showing how the transmission operates whether the throttle is open or closed. He told how the transmission is entirely automatic except for a button or hand control that will change the characteristics of operation from normal conditions to extraordinary conditions.

"Finger-tip control is not exactly automatic gear shifting but is really remote or dual control, as differentiated from the speed or torque method of control," stated Robert P. Breese, Bendix Products Corp., in his paper, "Automatic Shifting." With it, he continued, preselection is possible – making the lever go in a little ahead of time. Mr. Breese concluded by describing the various elements such as solenoid-operated valves, selector switch, and automatic clutch.

"The Mono-Drive is the right answer from the commercial viewpoint," contended Oscar H. Banker in discussion, explaining that it had been evolved only after considerable practical consumer research. "However," he qualified, "we don't claim that it is the ultimate." Then, assisted by slides and a half-size working model, he graphically supplemented Mr. Wolf's paper with descriptions of passenger-car applications and operating demonstrations.

"The important thing for us engineers to decide," believes E. Sydney Hall, "is whether the automatic transmission should simulate the driver's function or set up a separate control."

As Chairman of the Papers Committee, Herbert Chase read by title a paper written in Switzerland by Lowell H. Brown, Jarav Streamline Corp., that reports European road tests to determine the fuel saving from efficient streamlining.

George A. Round, automotive engineer, Socony-Vacuum Oil Co., has been appointed chairman of Metropolitan Section's Diesel Engine Activity to fill a vacancy left by T. S. Johnson, also of Socony-Vacuum, who has been transferred to Cairo, Egypt.

Lists Advantages of Rear-Engine Buses

● Cleveland

Greater floor space, less noise, minimized engine vibration, and more freedom from heat and fumes are a few of the advantages of rear-engine drive on buses, said Carl D. Peterson, executive engineer, Spicer Manufacturing Co., when reading his paper, "Rear-Engine Clutch and Transmission Developments" at the Feb. 8 Cleveland Section Meeting. Stephen Johnson, Jr., chief engineer of Bendix Westinghouse Automotive Air Brake Co., gave a supplementary talk on "Air Clutch and Transmission Control."

Continuing, Mr. Peterson explained that on rear-engine buses, when the outboard clutch is used, clutch adjustment and replacement is facilitated. He also said that this type of engine mounting makes for better weight distribution. Mr. Johnson described the air-control mechanism used with this installation. Because of the distance of the powerplant from the operator, he stated, an important problem is to gage the motor speed correctly at the time of shifting gears or engaging the clutch. In many instances, he added, shifting is rough and clutch life short. He explained that the air shift was developed to facilitate these operations and to make them fool-proof.

It was agreed by several discussers that because of the difficulty in estimating engine speed there is considerably more slipping of the clutch and that a one size larger clutch is necessitated. Even with this capacity, it was stated, both manufacturers and operators agree that clutch life is not satisfactory.

That because of correct weight distribution when the powerplant is mounted at the rear, one discusser pointed out that the same size tires can be used on all wheels.

Sees Vast Increase In Industrial Crops

● Detroit

"At least 50 million acres of farm land will be required in the next decade to produce crops for industrial use." This is one interesting fact quoted from a survey made by the Farm Chemurgic Council shortly after its inception in May, 1935, by Dr. H. E. Barnard, director of research of the Council, in speaking before members of the Detroit Section on Feb. 16. A recent estimate, he added, shows that over 6½ million acres are already producing crops which find use in the automobile industry in the manufacture of one million small cars. This, he declared, compensates somewhat for the 30 million acres taken out of production because of the displacement of the horse by machinery.

In describing the experiments being conducted at Atchison, Kan., in the manufacture of alcohol for motor fuel blends, Dr. Barnard said that the problem is to discover what particular starches or other carbohydrates are most easily and economically fermentable into alcohol. He considers the starch of the lowly artichoke potentially one of the most important farm crops from this standpoint, although cornstarch has been the chief standby thus far. The Atchison plant has a capacity of 10,000 gal. of motor fuel per day, requiring 4000 bushels of corn, each containing more than 30 lb. of starch. The most desirable blend of alcohol and gasoline, according to Dr. Barnard, is one containing 10 per cent alcohol. On this basis, he said, it will take 700 million bushels of corn, grown on 21 million acres, to supply 10 per cent of our present annual fuel requirements.

Stating that industrial uses of the soybean have gained wide recognition in recent years, he said that in 20 years the number of acres of this crop under cultivation has increased a thousand fold, and that there are 600 known varieties of the bean. Its principal asset, chemically, is its high protein content, 40 per cent, as against 10 per cent for corn, according to Dr. Barnard.

Furthermore, Dr. Barnard pointed out, there are plants already in operation in which soybean protein is produced in quantity for many industrial uses, such as the coating and sizing of paper stock and for the manufacture of glues and adhesives. Should the paper industry adopt this new method of sizing, the requirements would call for 15,000 tons of protein a year, he said. Other products listed, which contain some proportion of soybean oil, include artificial leather, celluloid, glues, linoleum, ink, rubber substitutes, paints and varnishes. The Department of Agriculture, he remarked, has recently established a research laboratory at the University of Illinois for the study of the industrial utilization of soybeans.

Many crops, the products of which are imported, could easily be grown in this country, according to Dr. Barnard. Tung oil, the basis of many superior varnishes and enamels, is a case in point. It comes from China at present, he said, adding that already there are 60,000 acres of tung-nut-bearing trees under cultivation on the Gulf Coast. Flax, hemp and sugar are other examples.

L. F. Livingston, manager, Agricultural Extension Section, E. I. duPont de Nemours & Co., in discussing Dr. Barnard's paper, pointed out that the engineer is the weak link in the farm-chemurgic problem and that it will be up to him to put the work of the scientist into practice. Primarily, he said, economics will determine the uses of the products of the research laboratory. Because our forefathers depleted our natural resources on such a lavish scale – in order for us to get where we are – Mr. Livingston says that this policy has brought us to the point where the economics of the situation dictate conservation and the discovery of substitutes.

Soybean oil is useful in the manufacture of synthetic enamels and is usually combined with synthetic resins, synthesized in the oil itself, according to J. L. McCloud of the Ford Motor Co., who was one of the discussers. Soybean oil is related to linseed oil and combines the properties of a drying oil and a non-film forming oil. It works best with Glyptal, a synthetic resin made from glycerine and pthalic anhydride, he concluded.

Quotes Laws of Nature In Paper on Cooling

● Canadian

Fundamental laws of nature – that mechanical energy and heat are interchangeable and that heat will always flow from a hotter to a cooler body quite regardless of the quantity of heat involved – are of primary importance in the problem of heat transfer as applied to automotive cooling apparatus, stated L. P. Saunders in introducing his paper "Anticipating Cooling Requirements," to the Canadian Section, Jan. 20. Ice-glazed streets kept attendance to 88 at the dinner meeting at the Royal York Hotel, Toronto.

Because these fundamental principles are involved, today's increasing demands on the cool-

ing system can only be met by improvement in design and refinement in detail, he explained. Stressing the difference existing in the volumetric capacity of the water which carries the heat to the metal and the air which carries the heat away from the outside of the metal, he explained, "we have on one side of the metal water, approximately 800 times the density of the medium by which it is cooled and approximately 3200 times the volumetric heat capacity, which in turn represents an air mass of approximately four times that of the water," and added "it is most necessary that this tremendous difference be appreciated." He pointed out the impossibility of proportioning the water and air surfaces in direct ratio to this difference.

Mr. Saunders made the interesting observation that a 350 cu. in. engine at 60 m.p.h. dissipates sufficient heat to warm a seven room house on a zero day. This, he said indicates the demand made on the cooling system of a present day automobile.

With the present grille design, he said, there are a number of cars on the market which at a speed of 60 m.p.h. have the radiators operating under conditions equivalent to 40 m.p.h., and this change is entirely due to the resistance of air flow set up by the grille and other ornamental material.

These are but a few excerpts from Mr. Saunders' paper in which he thoroughly treated the problem of anticipating cooling requirements. It supplemented his earlier paper, "Radiator Development and Car Cooling," which was printed in the December, 1936, SAE JOURNAL.

Canadian Section Chairman Max Evans introduced the speaker.

Talks on Theoretical Side of Ethyl Gasoline

• Denver

Eighty members and guests of the Denver SAE Club turned out on Jan. 15 to hear Archie Vallier, of the Kansas City office of Ethyl Gasoline Corp., talk on theoretical and practical sides of Ethyl gasoline. His talk was accompanied with instructive demonstrations. The Continental Oil Co. donated its auditorium for this meeting.

Presents Charter to Oldest Student Branch

• Ohio State

The Ohio State University Student Branch, the first SAE student branch to be formed, received its Certificate of Charter on Jan. 22. The presentation was made by E. F. Lowe, assistant general manager of the Society, who complimented the Student Branch on its splendid record since it was organized in 1925.

While on the Ohio State campus Mr. Lowe was drafted by the A.S.M.E. student group to address its meeting, pinch-hitting for the scheduled speaker who was unable to be present due to the flood.

The following new officers were elected for the winter quarter at the Student Branch's Jan. 8 dinner meeting: C. A. Hall, chairman; Eugene McPherson, vice-chairman; Robert Zinn, secretary and John Gayer, treasurer.

Student Members Hall, Zinn, G. E. Terpenny, and A. R. Shaw attended the SAE Annual Meeting in Detroit. On Jan. 15 they gave brief reviews of the sessions they attended at a joint SAE-A.S.M.E. meeting on the Ohio State campus.

Expounds Virtues of Cast Iron and Alloys

• New England

"Our old conception of cast iron being an unreliable, weak, brittle metal has been changed by coordinate efforts of engineers, metallurgists and foundries," said J. F. Walls, chief engineer, International Nickel Co., in his talk before the New England Section, Feb. 9. He continued, "It is now a versatile material possessing virtues where dependability and durability are primary requisites."

Cast crankshafts and camshafts must be reliable and economical to an extent equal to the wrought materials they have replaced, he said, adding that it is evident from the quantity now in use that parts made from cast materials are performing satisfactorily.

He went on to say that production engineers ask what factors justify the use of cast materials for forged ones in crankshafts and camshafts. Answering, he said, "They may be classified

as economy, engineering design, and material characteristics."

Mr. Walls then took each of these factors and explained how these characteristics are met. Details were given on fatigue properties. Damping capacity was then defined as the amount of work dissipated into heat by a unit volume of material during a completely reversed cycle of unit stress.

For the present, Mr. Walls continued, we can only assume that a crankshaft made of material of high damping capacity with moderate strength may have a greater effective strength and life expectancy than one made from material with much higher strength having a low damping capacity. Much of the current development of cast iron and its alloys for applications, as in crankshafts and camshafts, has been carried on with little specific information on the torsional properties of this material, he added.

Mr. Walls next spoke on several methods from a foundry standpoint which might be used in making cams. He said that crankshafts have been made from all kinds of materials, both in the forged and cast forms, but not until recently were cast products considered safe for high speed engines.

How the Ford Motor Co. evolved an alloy cast steel crankshaft after lengthy and costly experiments was told. Between 2,000,000 and 3,000,000 of them have gone into service with a marked reduction of failures below those encountered with forgings, Mr. Walls added. Slides and charts aided the speaker in making clear some of the matters in his paper.

Compares Efficiency of Diesel and Steam Trains

● Milwaukee

New Diesel locomotives on streamlined trains show an improvement of three to one over the conventional steam locomotives in overall efficiency between the fuel and the power on the wheels, E. F. Weber, superintendent of automotive equipment, Burlington Railroad, told some 200 members and guests of the Milwaukee Section on Feb. 5. This has reached 27.5 per cent, he stated.

Speaking particularly of the eight Burlington Diesel trains which have several million miles of main-line travel to their credit, he told of the initial difficulties that had to be overcome with these new and unknown engines and equipment. Before reading his paper Mr. Weber had moving pictures run showing these trains on record-breaking trips.

That the subject of streamlined trains is of interest to Milwaukee Section members was evidenced by the prolonged discussion which continued long after the usual closing hour and, even then, had to be cut short by the chairman.

Past-President Roos to Head Advisory Committee

D. G. Roos, technical adviser, Studebaker Corp., is the new chairman of the SAE Past-Presidents Advisory Committee. He takes this office following recent action of the Committee, based upon a suggestion by Col. H. W. Alden who has been chairman since its inception, "That at the beginning of each Society administrative year, the chairmanship of the Past-Presidents Advisory Committee shall fall to the lot of the past-president who at that time has just finished his services as a member of the Society's Council."

Talk on Valve Steels Stimulates Discussion

● Pittsburgh

Higher engine output and greater speeds have placed increased demands upon valves. How these demands are being met with the development of new steel alloys was explained by Harry D. Bubb, chief engineer and metallurgist, Thompson Products Co., before 80 members and guests of the Pittsburgh Section, Jan. 26. He spoke in the place of Archie T. Colwell, Thompson Products' vice-president in charge of engineering, who was prevented by illness from attending.

In the discussion which followed his paper Mr. Bubb explained that better materials and improved design have been used to overcome the warping of valves that took place in early airplanes due to the rush of cooler air past the valves during power drives.

Answering a question by George W. Brisbin, Peoples & Columbia Natural Gas Companies, as

to width of valve seats, Mr. Bubb said that he considers a seat of moderate width best for automotive use. Wide seats, he explained, are used in airplane engines because of use of softer metals and sustained full-load operating conditions.

Regarding sticking valves, Mr. Bubb said that some qualities of oil seem more apt to cause this trouble than others. Asked by Charles Noll, Gulf Oil Co., whether he had been able to obtain any correlation between oxidation points of oils and their tendency to cause valve sticking, he answered that many tests have been made but that because so many other factors have to be considered no definite correlation has been obtained.

Section Chairman Stephen Johnson, Jr., Bendix-Westinghouse Automotive Air Brake Co., mentioned some difficulties he had experienced with air-compressor valves during recent years which were probably due to changes in methods of refining oils. These have been overcome, he said, by using dewaxed oils of good quality.

Charles R. Lund, American Oil Co., Ralph Baggaley, Jr., McCrady-Rodgers Co., and Robert Austen were among others contributing to the discussion.

Dance Supplants Technical Meeting

• Northwest

Technical matters were thrown overboard when the Northwest Section held a dinner dance at the Hotel Roosevelt, Seattle, Jan. 22. At the dinner Sherman Bushnell and John Holstrom, returned travelers, described their recent trips. Mr. Bushnell's 12,000-mile motor tour took him through Pasadena, Calif., where he witnessed grinding of the 200-in. glass mirror which is being polished at the California Institute of Technology for the world's largest telescope, and also to the Texas Centennial Exposition. Mr. Holstrom visited the industrial centers of the Middle West.

About 45 people attended the dinner and an additional 15 came in later for dancing. Guests of the Section included Mr. and Mrs. N. A. Carle, Mr. and Mrs. H. A. McMorris and Mr. and Mrs. E. C. Van Horn. Mr. Carle is Seattle's city engineer and Mr. McMorris is on his staff. Mr. Van Horn supervises the city's new automobile testing station.

Links Car's Shape and Its Lubrication Problem

• So. California

"Nothing has greater effect upon lubrication requirements of the modern car than its appearance." So said G. L. Neely, research engineer, Standard Oil Co. of Calif., in his paper, "Lubrication Trend in 1937 Car Design," before the December meeting of the Southern California Section. In explanation, he continued, "With changes in appearance, not only come changes in operating temperatures, loads and speeds of the powerplant and its appurtenances, but even their very design, their location and their control are to a large degree influenced by the shape of the car itself."

The definite trend toward higher power output, he said, continues in 1937 and aggravates such problems as oil consumption, oil temperatures, oil distribution, and bearing loads. The control of oil consumption at high speeds is mainly accomplished by the use of more and better piston rings, he said, mentioning particularly the Perfect Circle X-90 oil and compression rings which utilize a series of double-leaf spring units equally spaced on a carrier band, the gap being located opposite the ring gap. The expanders, he added, are claimed to maintain uniform ring pressure at all speeds.

The author went on to say that further control has been obtained in some cases by the use of compression rings with tapered faces and also in the use of narrower rings. Pistons with four and five ring combinations will be more common in 1937 than ever before, he added. In this respect he stated the necessity of emphasizing that the control of oil consumption by the use of more rings, narrower ring faces and beveled faces tends to starve the upper rings at lower speeds and that a definite deficiency in ring lubrication may result from such a trend. Actual tests, he stated, only can determine whether or not increased speeds and loads will require crankcase oils that are compounded to improve oiliness or film strength properties.

On the subject of rear-end design, Mr. Neely declared, "By all means the most important development in 1937 cars is the wide adoption of the hypoid rear axle." He referred to recent papers by Austin M. Wolf and Walter R. Griswold which deal in detail with factors in-

fluencing the lubrication of hypoid gears. These axles, he said, must now be lubricated with a product which is chemically reactive with steel gears to render them less subject to scoring. Hypoid-gear lubricants, he continued, are not so stable as the best highly treated straight mineral oils, but they are adequately stable and rapid progress in lubricants of high film strength and high chemical stability will constitute our next gear-oil development.

In his paper Mr. Neely touches practically every phase of lubrication, noting among other things that plated pistons will be more generally used because of their low coefficient of friction against cast iron with the consequent lessened tendency toward scoring, and their resistance to wear.

He also pointed out that the chemical reaction characteristics of motor oil is now of much significance in the breaking-in of new engines and that some manufacturers are already having to plate their cam shafts and other parts to prevent their scoring during the breaking-in period.

C. T. Austin represented the Aviation Section of the Southern California Section at a meeting of the National Aeronautical Association held in Los Angeles Jan. 21. Twenty-three other aircraft organizations were represented. Mr. Austin is chairman of the Section's membership committee.

Glynn and Lowe Speak Before Pratt Students

"Opportunities for Young Engineers in Fleet Operation and Maintenance," was the subject chosen by F. K. Glynn, automotive engineer, American Telephone and Telegraph Co., when he addressed 55 students at Pratt Institute, Brooklyn, N. Y., Feb. 2. SAE Assistant General Manager E. F. Lowe also spoke before the students, setting forth the advantages of student membership in the Society.

SAE Annual Meeting Reported by Savage

● Oregon

Bringing the story of the SAE Annual Meeting in Detroit to the Oregon Section was Verne Savage's part at the Section's February meeting, held Lincoln's birthday in Portland. As the Section's delegate he submitted a log of his trip enlivened with experiences on the Diesel-operated streamliner which took him East.

There is considerable interest in passenger-car Diesels, Mr. Savage said in discussing new developments in the industry, adding that interest also continues in rear-engine vehicles. He mentioned that experiments are being made in solid-fuel injection, that gear lubrication is being improved and that new features are coming up that will make the car of today obsolete in a few years.

The reason for so much talk about hypoid gears, Mr. Savage said, is to impress the public with the necessity of lubricating them properly and not because any trouble is expected to develop from them. The subject of hypoid gears precipitated a lively discussion in which O. E. Dagner, S. C. Schwarz, Otto Struss, Kenneth Ayers and others took part.

Besides touching the highlights of the meeting, Mr. Savage also reported that he found time to talk before the Detroit Automotive Trades Association on periodic inspection of motor vehicles, and to visit William B. Stout's plant where he inspected the new Scarab car and the trailer-home.

"Why do oil companies usually recommend lighter oils for cars than those specified by the factory?" a question from the Section's Question Box, was answered by Mr. Schwarz. In his opinion manufacturers specify oils heavy enough to serve under the most unfavorable conditions of operation. He stated that maximum working temperatures for SAE 10 paraffin-base oil is 165 deg., for SAE 20, 188 deg., and for SAE 30, 225 deg. With SAE 10 oil, he continued, metal to metal contact can be expected at a temperature only slightly above the point where thermostats cut in. Mr. Schwarz pointed out, however, the economy of using light oil. He said that tests have proven that changing to oil one grade lighter can save 3 per cent in gasoline consumption.

Mr. Struss announced that a full Chevrolet knee-action assembly is being presented to the Oregon State College Student Branch by the Section through the courtesy of Field Motor Co.

SAE Men Participate In Aircraft Meeting

"It flies pretty fast, but it ought to climb better," is a typical test pilot's report of the behavior of a new plane, said Edward P. Warner in his paper advising airplane builders to follow the road taken by the automobile industry ten years ago when it established proving grounds. Mr. Warner's paper was read before the Institution of the Aeronautical Sciences during its fifth annual meeting in New York, Jan. 27-29. Many other SAE members were prominent on the program.

Continuing, Mr. Warner said, "Until the auto industry introduced proving grounds the test driver's verdict was supreme. Thereafter it was supplanted by the coldly unchallengeable testimony of recording instruments." Such measurement is needed by aircraft builders – particularly of four general factors, he added, listing them as static stability, dynamic stability, the maximum control action obtainable by maximum use of controls, and the lightness of the control forces with which a given action can be obtained.

Mr. Warner went on to say that nothing is really understood until it can be measured, adding that there should be developed instruments fit to make the measurements decided upon. Thanks to the National Advisory Committee for Aeronautics, he said, 80 per cent of the instrumentation is ready and waiting, while the rest is in an advanced state of development.

At the Annual Dinner of the Institute, Jan. 27, Dr. J. C. Hunsaker, Luis de Florez, and Charles L. Lawrence described, demonstrated and exhibited a machine for testing the "multivibrational beta" defined as "a pneumatic acoustic phenomenon made by the lips and tongue to register varying degrees of disapproval," later recognized as the "Bronx cheer." The stunned audience remained silent for a moment and then accompanied further detailed analysis and description with gusts of laughter.

Other SAE men participating in the dinner program were Arthur Nutt, Stephen J. Zand and James B. Taylor, Jr., who spoke on aviation in the various European countries. It was announced that Sherman M. Fairchild, Dr. George W. Lewis, E. E. Wilson and T. P. Wright are among the new vice-presidents of the Institute. Elmer A. Sperry, Jr., is treasurer.

Mr. Wright presided at the opening day session on "Structural Problems in Aircraft Design." In another first-day session featuring "Long Range Seaplane and Airship Problems," Rex B. Beisel read his paper "Why Use Cowl Flaps?" Mr. Nutt was chairman of the Engines and Fuels Session on the second day, at which Maj. E. E. Aldrin presented his paper, "Progress in High Octane Fuels," C. S. Draper was coauthor of a paper on "Vibration Measuring Equipment," Andrew V. D. Willgoos' paper on "Reduced Maintenance of Aircraft Powerplants" was read by Robert Insley, and L. B. Kimball spoke on "A New Octane Control and De-Icer." Among the discussers were C. F. Taylor, H. K. Cummings, and Graham Edgar. The General Aerodynamics Session was headed by Dr. Hunsaker.

Dr. Lewis was in the chair during the Airplane Stability and Performance Session at which Alexander Klemin read his paper "Design Application of Longitudinal Dynamic Stability Theory."

About Authors

(Continued from page 11)

Highland Park dynamometer laboratory, developing engines for passenger-car, truck and marine use.

• Tom A. Triplett *pioneered in metallurgical diagnosis by X-ray in 1925 when he examined material for facing cars. He worked with Babcock and Wilcox Co., examining the welding on the steel penstock at Boulder Dam. He left there to do research work at the California Institute of Technology and later assumed directorship of the physical testing laboratory at Douglas Aircraft Corp., Santa Monica. Mr. Triplett attended school and received his early aircraft training and experience in Denver, Colo. He is the founder of Triplett & Barton.*

• Herman E. Winkler *went from Purdue University, where he was graduated from the Mechanical Engineering School in 1927, to the drafting board at the Schwitzer-Cummins Co. He passed through the assistant stages to the chief engineer's job, in which capacity he served for about five years. He recently resigned from the Schwitzer-Cummins Co. to take office as vice-president in charge of engineering and sales, Winkler Manufacturing Co. He has been a member of the SAE Diesel Activity Committee and is a past-chairman of the Indiana Section.*

An Automobile Engineer Looks at Highway Safety

By W. J. Davidson
General Motors Corp.

ABOUT a year ago the subject of highway safety was "front-page" news.

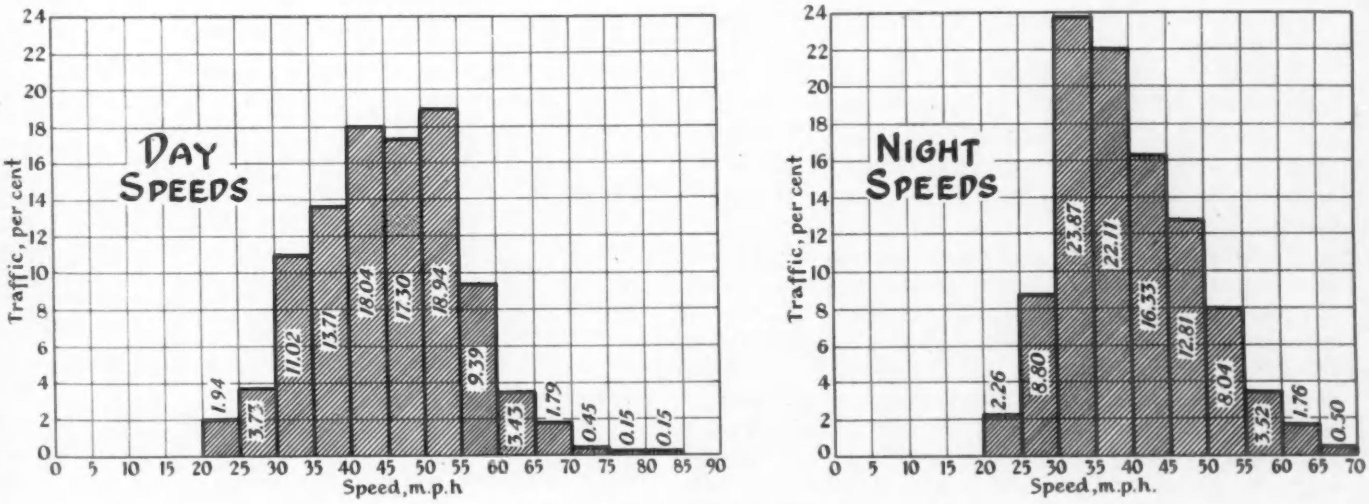
Although the prominence of this publicity wave seems to have passed its peak, the enforcement officials, consisting of State Administrators, police authorities, etc., are still very much exercised over the situation due to the fact that, despite all the activity to prevent it, the total fatalities for 1936 exceeded those of 1935. In this connection it is only fair to point out that some progress has been made because usage – as measured by gasoline consumption – was up about 10 per cent during 1936 – and therefore, on the basis of miles traveled, the fatality rate is trending downward.

Without bothering to reiterate a lot of statistics dealing with accidents which have been published in various forms and some of which material has had rather wide circulation, I do make a plea to everyone, and particularly to those dealing with the design, manufacture and maintenance of automobiles, to secure and study these statistics in order to profit from the inferences which can be drawn therefrom.

The real question in connection with this whole business that affects us as automotive engineers is: "What is our responsibility in connection with all this?"

The first step in the solution of any problem is that of ascertaining the facts surrounding the problem. It is here that we run into our first difficulty – that of obtaining accurate accident data. It is next to impossible to say how many auto-

How Fast Do People Drive?



General Motors, with the cooperation of the Michigan State Police – timed the average speed of automobiles on a 5-mile, 4-lane highway between Flat Rock and Monroe, Mich., last fall for 4 hr. 7 min. during a daytime period and for a 3 hr. 9 min. period during the evening. The two tests were made on separate days.

In the daytime test the average speed was 45.21 m.p.h.; in the night test 39.78 m.p.h.

Weather during the daytime test was slightly overcast to cloudy and warm; during the night test clear and cool.

Total number of vehicles checked during the daytime test was 671; during the night test 398.

mobile accidents are due to any particular cause, since to determine the cause of accidents requires more careful investigation than is usually made. Further, most automobile accidents are the result of a combination of causes which further complicates the situation.

There is one thing we do know. All accidents involve three major factors:

1. The highway.
2. The human factor (and in this classification we would include the driver – the so-called "other fellow" or a pedestrian).
3. The car.

Only quite controversial figures can be arrived at as regards the proportionate responsibility for accidents of each of these factors, but study of all the data indicates that very conservatively speaking on the high side, the car is held primarily responsible for approximately 10 per cent of the accidents. This leaves, then, 90 per cent to be divided between the other two factors.

Foreign Experience

Bearing on the above point, the following quotation from an article which appeared recently in *The Spectator,* a London paper, dealing with a report on fatal road accidents in Great Britain for the year 1935, compiled by the British Ministry of Transport, is pertinent:

"There is no minimizing the shock of the figures that show how the blame for fatalities is apportioned. Roughly speaking the Report proves, so far as proof is possible, that the emptier and therefore the safer the roads the more frequent the accidents.

"It is worth while repeating the figures: out of 6500 accidents in which 6500 people lost their lives, more than 60 per cent happened on straight or open roads with good visibility, and about the same percentage happened 'under conditions of very light traffic.'

"Against the latter, which actually numbered 3766, only 215 took place in dense traffic. The part borne by the roads themselves in these accidents must be very small. All our preconceived notions are thereby upset. The fault lies in the users of the highway and not, as one had hoped, in the builders."

As engineers, the first thing we would naturally think of is to determine in detail the facts dealing with our share of the responsibility for accidents. I attempted to do this by segregating the mechanical failures by classification and percentage and found that the variation percentagewise was so great that all it told me was that the figures didn't mean a thing. I therefore make a plea to the enforcement people to organize as promptly as possible to supply us with accurate, comprehensive, factual accident data, compiled on a nationwide uniform basis, so that we engineers can learn something about what we, justly or unjustly, are being blamed for.

Now, let us deal with another important factor bearing on our share of the responsibility. Our figure, under the circumstances, seems insignificant, but our responsibility goes far beyond the 10 per cent due to the fact that we are criticized for placing the driver in an environment and with potentialities which tempt him to take chances and generally to so conduct himself that he can become a greater than 10 per cent hazard on the road.

In connection with the automobile from a safety standpoint, its characteristics may be divided into two general classifications. First, there are those items which affect the maneuverability and control – such items as steering, brakes, acceleration, top speed, vision, comfort of the seats, position of the steering wheel, position of the pedals, headlights, etc., which in the main deal with what might be called the environment items which affect safety. By means of any or all of these devices, the operator can avoid accidents. When you think of a car in these terms, the word "agility" applies very well. One can stop out, steer out, or accelerate out of an accident, and the physical and mental ease with which the driver can execute these maneuvers has a great deal to do, in my opinion, with the safety of himself and the occupants of the car.

Expressed another way, the engineer wants to make things in general so easy for the driver that he is mentally free to size up the road situation at all times. He should be able to concentrate on his job of driving without being hampered by adverse environment influences. The driver's viewpoint should constantly be kept before the engineer in dealing with these environment items. Further, it is unnecessary to add that good road-holding ability should be incorporated in the car as this is desirable from a safety standpoint whether the driver is conscious of it or not.

The other division of safety in the car itself is that of the structure. This becomes of paramount importance when one has exhausted all the maneuverability features and strikes or is struck by something. As far as can be determined, there is very little criticism of the structure itself on the part of motor vehicle administrators except in rare instances where some type of specific "bug" is found in a certain car.

It is under the general heading of structure that the mechanical items comprising the 10 per cent failures for which we are held responsible, fall. This includes such items as steering gear failures, bursting tires, brakes, etc.

Speed and Headlights

The features which are under the heaviest fire – which come in the maneuverability classification – are undoubtedly top-speed and headlamps.

As to speed, there seems to be a marked tightening of speed regulations, particularly in Eastern States. There is some discussion of putting governors on cars to limit their top-speed. The effect of these on safety is highly questionable. There are no facts available, from the private owner standpoint, but best opinion would indicate that governors might well increase the hazards on the highway instead of decrease them.

We do have a few statistics on this point, but they come from abroad.

The small popular-priced cars are, in a sense, equipped with governors – that is, their engines are so small that they are unable to achieve "top-speed" in our sense of the meaning of the word.

Now where are they statistically?

It is interesting to note that Canada has 9.9 fatalities per 10,000 vehicles running, the United States has 13.6, whereas England has 30.6, Scotland has 44.8, and Italy 59.4.

Evidently lack of power in a motor car is not the answer to the safety problem.

Incidentally, General Motors attempted to find out how fast people actually were driving in the Michigan area by going out on two of the most widely traveled roads in this part of the country and – with the help of the Michigan State

Police – making a series of tests. These tests revealed the facts as shown in the charts on the preceding page.

These show the average speed on Telegraph Road between Flat Rock and Monroe, Mich. The speeds were taken both by day and by night.

It is apparent that a majority of people are not traveling as fast as is generally supposed – and it should be remembered that these averages were compiled on open roads in the country where there is no speed restriction.

Headlamps still remain one of the great controversial subjects – which a brief paper could not hope to discuss adequately. Suffice to say that engineers are doing their best to provide the safest lighting that they know about and that their efforts to find something better are unceasing. One obvious thing should be emphasized in connection with headlamps: You cannot very well avoid something which you can't see. Therefore, what we need is plenty of light. The problem which engineers have to work on is how to have this light and at the same time provide adequate relief from glare.

Vision is another of the features of our cars which is widely criticised and, of course, is tied up with the structure. It is fair to say that the 1937 product of the industry shows some improvement along this line, but there is a great deal yet to be done and from all reports everyone is working very actively toward this end. Both the interior and exterior of automobile bodies have had attention from a safety standpoint and will get more in the future.

Bumpers have come in for criticism because of their locations. Doctors have stated that bumpers are placed at a point where collision with the pedestrian causes serious accidents because fractures taking place below the knee are more difficult to correct than above the knee. They suggest raising the bumper and making it much wider so that there will be a distribution of the effect of the blow.

Engineers, of course, are interested in all phases of the automotive industry but are engaged principally in the design and manufacture of new automobiles. It is fair to say that they have done a fairly good job. They are more conscious of the importance of highway safety in connection with the design and manufacture of their product than ever before and it is my opinion that we are just off to a good start in this connection. It must be remembered, however, that when we have designed, produced and delivered a new automobile to an owner, the responsibility for its proper operation then passes to the enforcement authorities from a discipline standpoint and to our service departments from a maintenance standpoint.

Design for Maintenance Safety

"Maintenance for safety" is a very important thing and engineers should, when designing cars, bear constantly in mind the importance of making them easy and economical to maintain in order that the vehicle may be kept – in the hands of the owners – in as nearly its original condition as possible.

This brings up the question of what is being done in the field on compulsory inspection. This activity has increased and is continuing to do so. While the full effect of this type of inspection has not been reflected in the accident record, we believe that it will contribute considerably – at least in a psychological way – to the cause of safety. It will also probably have the effect of ruling off the road cars which cannot be made mechanically safe.

It behooves all of us again to get actively behind what used to be called in the earliest days of the automobile business, the "good roads movement." In the old days a good road between two important centers of population was merely one which had a hard surface which would prevent your sinking into the mud. This is no longer the case. We should all get out and do what we can to further the modern "safe roads movement." In this the engineers are supporting the industry, because if engineers are to grow and prosper they need good safe modern roads and lots of them.

"Headlamps still remain one of the great controversial subjects – which a brief paper could not hope to discuss adequately. Suffice to say that engineers are doing their best to provide the safest lighting that they know about and that their efforts to find something better are unceasing.

"One obvious thing should be emphasized in connection with headlamps: You cannot very well avoid something which you can't see. Therefore, what we need is plenty of light.

"The problem which engineers have to work on is how to have this light and at the same time provide adequate relief from glare."

One point on the human factor is that a very practical selection of drivers is in the offing. This, of course, means a tightening down of license requirements, passage of license laws in states where they do not exist, etc.

Probably the most recent development in this connection is that psychologists are attempting to develop apparatus and instrumentation to determine whether or not a person is capable of operating a motor car safely under modern conditions. It is too early to say what the effect of this apparatus will be. It would seem to me that it will be desirable for each engineer to take a helpful attitude in connection with these driver selection activities. An important point to be borne in mind, however, is that some people are prone to look on these activities as a magic solution to the safety problem. We must steer clear of any activity whereby persons wholly competent to operate a motor car might be ruled off the road and, further, we must beware of procedures whereby the use of the automobile will be restricted without any resultant benefit.

Proper technical relationship between our industry and the enforcement authorities is assuming great importance. In my opinion, this trend will continue at an accelerated rate. It is very apparent that each engineer constantly must bear in mind in designing and manufacturing cars, the contribution which he should make toward keeping our product "sweet" and continually "sweeter" with both the public and the enforcement authorities. We should also bear in mind the tangible mechanical things and the other features which we might call intangible, but which are looked upon by the authorities as our responsibility.

Let us be very jealous of our prerogative of designing the car. It is one which justly belongs to us as engineers – but let us exercise this prerogative so actively and so progressively from a safety standpoint that there can never be any question in the mind of anyone but that it is being used wisely and with all the ingenuity of which human ability is capable.

European Aviation Boom Portrayed

WITH the tremendous amount of money being poured into aircraft production and research facilities in Europe, this country will be forced to take drastic steps if it expects to maintain its position from both commercial and military standpoints, warned Arthur Nutt, vice-president in charge of engineering, Wright Aeronautical Corp., concluding his speech on "European Aviation Engines" at the banquet that closed the 1937 National Aeronautic Meeting at The Mayflower, Washington, D. C., March 11 and 12.

Preceding the banquet, 6 technical sessions and an inspection trip left few spare moments for the 300 attending the two-day meeting. On the first day a cash value was put on the earning power of high antiknock fuels and improved methods for testing for the stability of aircraft lubricants were reported in the Fuels and Lubricants Session. In the Vibration Session that evening, two papers received high praise – one describing apparatus for measuring vibration in flight, and another explaining the influence of vibration on propeller design. Two Engine Sessions on the following day discussed carburetion, fins, reduction gears, valve seats, service ratings, and lubrication and cooling systems. Present and proposed interior facilities for passenger comfort, French airplane engines and propellers, and airport design made up the varied components of the Aircraft Design Session. The effects of laminar and turbulent boundary layers were discussed in a session devoted to practical aerodynamic problems, along with the practical applications of Fowler flaps.

One of the many contributions of the SAE Washington Section was the tour of the laboratories of the National Bureau of Standards in which tests and research covering a wide scope of aircraft engineering were revealed to over 120 on the first afternoon. C. S. Bruce, T. T. Neil, and H. K. Cummings, all of the National Bureau of Standards, made up the committee from the Washington Section which cooperated with the Bureau to make this trip possible.

Washington Section Active

The meeting was sponsored by the SAE and its Washington Section with the cooperation of the Aeronautical Chamber of Commerce of America, the Air Transport Association of America, the American Society of Mechanical Engineers, and the Institute of the Aeronautical Sciences.

All contributed to make the meeting an outstanding success. A high percentage of the country's top-ranking aircraft engineers attended, including five Manly and Wright medal winners. The banquet marked the first appearance before an engineering gathering of Dr. Fred D. Fagg, Jr., the recently appointed Director of Air Commerce; he was introduced by his superior, Col. J. M. Johnson, Assistant Secretary of Commerce.

Before Mr. Nutt's speech over 180 at the banquet had seen Paul B. Lum, vice-chairman of the Washington Section, acting in the absence of Lieut. Col. B. O. Lewis, chairman of the Section, turn over the gavel to C. H. Chatfield, toastmaster.

"Thank you for standing up; in Detroit where I come from, everyone seems to be sitting down," was the apt way that Harry T. Woolson acknowledged the standing tribute following his introduction, in his first appearance before the Washington Section as President of the SAE.

In a more serious vein, Mr. Woolson expressed the appreciation of the Society to those organizations cooperating in making the meeting a success, as well as to the Aircraft-Engine and Aircraft Activities of the Society, whose vice-presidents are A. L. Beall, Wright Aeronautical Corp., and F. E. Weick, Engineering & Research Corp. He went on to compare the problems of aircraft and automobile engineering, indicating what each is learning from the other, and pointing out their differences.

Alert Engineers Needed

"Just pause a moment and you are far astern – and a stern chase is a long chase," admonished Col. Johnson, the next speaker, drawing attention to the responsibility of aircraft engineers to their industry and to their Nation. "Do not forget," he concluded, "that the Department of Commerce is your help-meet and collaborator always ready to promote or assist you in your work."

Lifting a quotation from Mr. Woolson's speech, "That nothing is done finally and right – that nothing is known positively and completely," to confirm his point, Dr. Fagg expressed the hope that the key phrase in the aircraft industry will be that we really do not know the answers.

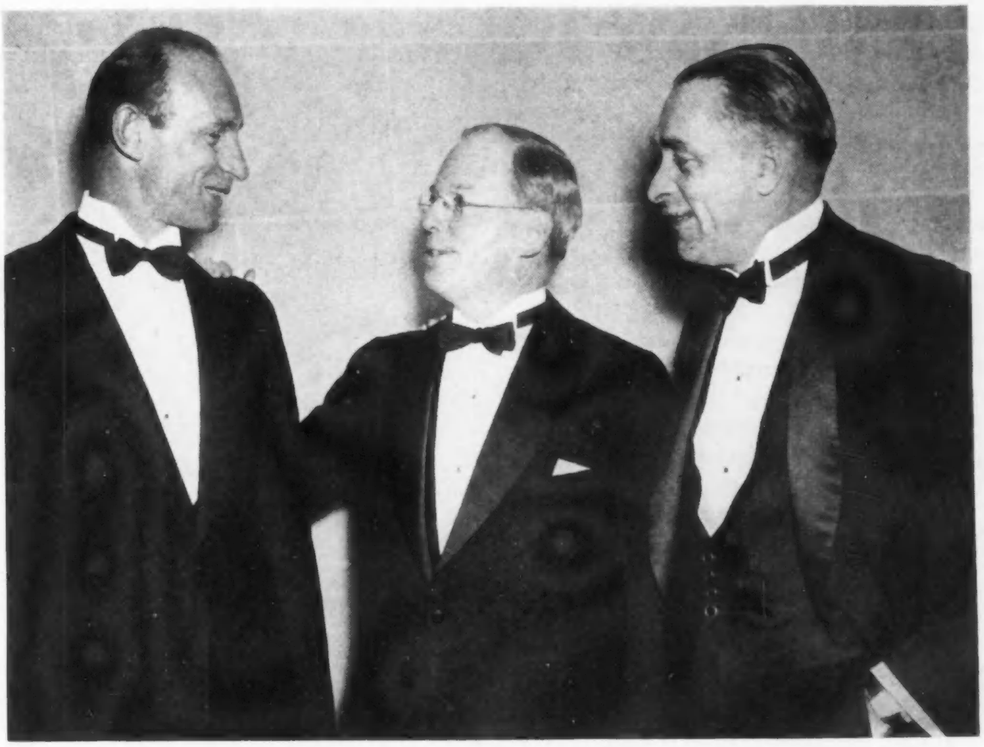
After reviewing the pioneering achievements in aircraft-engine engineering of Charles Matthews Manly in whose memory the Manly Memorial Medal was established, Dr. George W. Lewis, as chairman of the Committee for Awards, presented the Manly Medal for 1936, for the best paper on aeronautic powerplants presented before the Society in that year, to Raymond W. Young, Wright Aeronautical Corp., for his paper: "Air-Cooled Radial Aircraft-Engine Performance Possibilities," presented at the 1936 Annual Meeting of the Society and published in the June, 1936, issue of the SAE Journal.

"Progress in European aviation engine production has been extraordinary in the last two years," believes Mr. Nutt, who explained that his European visit afforded him an excellent opportunity to make comparisons with a trip made two years ago, "although production is only half as large as several published opinions would have us believe."

Then, taking listeners on a 30-minute tour of the aviation-engine industries in principal European countries, he reported:

England has some of the most modern aircraft engines in the world with several military aircraft that are making speeds of between 300 and 350 m.p.h. at 15,000 ft. altitude. . . . English aircraft engine factories have about five times as many engines on their books as we have now . . . perhaps the most outstanding development in Europe, or the world, is the sleeve-valve aircraft engine developed by A. H. R. Fedden.

at National Aero Meeting



SAE President *Harry T. Woolson* (center) talks over the meeting with *Fred E. Weick* (left) and *A. L. Beall* (right), Vice-Presidents of the Aircraft and Aircraft-Engine Activities, respectively, which sponsored the meeting. Mr. Woolson spoke at the banquet.

Germany is making engines that are seven or eight years old in design, Mr. Nutt announced, but this enables them better to develop their production facilities and to train personnel while developing models of advanced design. Expansion of factories, laboratories, and equipment within the last two years is very impressive, he added, with the Junkers factory alone providing more floor space for aviation-engine production than all the airplane engine factories in the United States put together. The Heinkel factory has 800 draftsmen at work. Many factories are provided with underground bomb-proof rooms for the workers.

Considering their handicaps of inadequate transportation facilities and shortage of trained personnel, Mr. Nutt feels that progress in Russia has been remarkable. Russian factories employ about twice as many workmen per unit of manufacture as in the United States and have many unnecessary operations, their purpose being, Mr. Nutt explained, to train men for expansion programs.

Italy's expansion program is well under way, he continued, but the quality of workmanship and material was not impressive, probably because of a shortage of trained personnel and high-grade materials, Mr. Nutt added, stating that Italy also employs an excessive number of workmen to effect a training program.

Strikes and labor disturbances in France have caused her to fall behind other European countries, according to Mr. Nutt, adding that the government is taking over complete charge of the aircraft industry.

Unless national emergencies automatically take care of the situation, Mr. Nutt predicted that all of these countries will soon be in a state of over-production. Summarizing, he called attention to a definite trend in Europe toward air-cooling, and stated that Diesel-aircraft-engine development seems to be concentrated in Germany on account of the difficulty in getting a sufficient quantity of satisfactory gasoline in Germany.

Lest his survey be taken too pessimistically, Mr. Nutt concluded by stating that production efficiency appears to be lower in Europe and that it is difficult to compare conditions in this country directly with those in Europe where political and international affairs are so different.

Earnings of Higher-Octane Fuels Figured

"The earning power of octane-number improvements is so great that, within practical limits, the cost of these fuels cannot influence the trend toward them," contends Dr. D. P. Barnard, Standard Oil Co. of Ind., summing up his paper: "The Value of Octane Numbers in Flight." This was the first of two papers presented at the Fuels and Lubricants Session that opened the meeting and for which more than 175 turned out. A. L. Beall, Wright Aeronautical Corp., was chairman. New and improved methods of testing for the stability of aircraft lubricants were described in the second paper entitled: "Engine and Laboratory Tests of Stability of Aviation Oils," by Dr. O. C. Bridgeman, National Bureau of Standards.

"Every time a gallon of aviation gasoline is improved by

one octane number," continued Dr. Barnard, "its earning power is increased from 2 to 8 cents, depending upon design and operating conditions. The procedure consists in computing the change in earning power of a gallon of gasoline when octane-number changes are reflected in altered fuel consumptions or take-off load capacities.

"To attain flying speeds within the confines of airports of practical dimensions," he pointed out, "land-transport airplanes have been held to a power loading of very close to 13 lb. per hp. but, if conditions permit the use of higher power loadings, larger loads can be carried with any amount of available power." Dr. Barnard then developed his formula for computing this earning power based on such factors as specific fuel consumption, weight of fuel required, maximum cruising range, cruising speed, cruising horsepower, heat value of fuel, and so on.

Improvements can be rated even higher for military service, Dr. Barnard added, whether to increase the performance of a combat plane or the range and capacity of a bomber, stating that he had made no effort to evaluate these improvements.

But such increases in earning power will not come but rarely by the simple expedient of "pouring in higher antiknock fuel and opening the throttle wider," warned Dr. Barnard in conclusion – they must be accompanied by design changes made possible by the improvements in fuel.

Flight Tests Needed

"The real value of special fuels or blending agents for aviation gasolines can be determined only by actual flight tests," claims Major E. E. Aldrin, Standard Oil Development Co., in written discussion. Such computations based on ordinary hydrocarbon fuels would give earnings that are too low if applied to benzol blends of aviation fuels, he contended, pointing to flight tests in Europe that showed the performance of benzol blends in cool-running engines to be appreciably in excess of that of straight-run leaded fuels of the same A.S.T.M. octane number.

The advantages to be obtained by the lower maintenance costs resulting from the use of the higher antiknock fuels were stressed by T. B. Rendel, Shell Petroleum Corp., in written discussion read by F. L. Garton, Shell Petroleum Corp. "There is," he believes, "little doubt that many airplanes operating on the ragged edge of detonation would show some reduction in maintenance costs if the operators would agree to pay slightly more for a higher antiknock fuel for the majority of their running, rather than use it merely in take-off."

More data on the actual costs of these higher antiknock fuels with which to compare their earnings were requested by T. P. Wright, Curtiss-Wright Corp.

Answering his discussers, Dr. Barnard explained that his results were conservative because he did not want to give the fuel all the credit for improvements. In reply to Mr. Wright, he stated that in quantity commercial iso-octane costs relatively little more than ordinary aviation gasolines.

"To develop a suitable laboratory method for oil stability that would give results significant in terms of the service changes in these oils when used in aviation engines," was the purpose of the investigation reported by Dr. Bridgeman. Three general laboratory methods were chosen, he explained: heating the oil with the surface exposed to the air but without aeration, heating the oil under aerating conditions, and heating the oil while flowing in a thin film exposed to air down the inside walls of a heated steel cylinder and recirculating the oil periodically at a controlled rate.

The results reported, he continued, were obtained on 22 oils using the first two methods only. By comparing these results with those of tests of the same 22 oils on a Pratt & Whitney engine, he showed by curves that data obtained by the first method of heating without aeration correlated closely with those of the actual engine tests. Data gathered included viscosity, carbon residue, naphtha insoluble, carbon residue, chloroform insoluble, and neutralization number, at different temperatures and periods of time.

Laboratory Study of Oil Stability

"Laboratory methods for oil stability can be developed that will rate a series of oils in almost any order, depending on test conditions," and "heating of oils without aeration at 175 deg. cent. appears to be the most significant set of test conditions that correlate satisfactorily with service performance of the oils in aviation engines of moderate output," are two important conclusions of Dr. Bridgeman's paper.

"Due to the multiplicity of oils and the multiplicity of problems," G. L. Neely, Standard Oil Co. of Calif., feels that the lubricant must be selected to take care of the specific problem. In this connection he wondered whether stability in aviation oils was the factor that was holding up development. "If you will define the problem," he concluded, "we will define the oil."

"The problem is divided into three forms," specified C. M. Larson, Sinclair Refining Co.: effect of sludge, ring-sticking, and ring and cylinder forms. The relation of the asphaltene content to the total sludge is highly important, he believes.

The Indiana oxidation test has its limitations when applied to aviation lubricants, conceded Dr. Barnard, explaining that it was developed for automobile oils. However, he believes that the chloroform insolubles are not all dust or extraneous matter in every case, as assumed by Dr. Bridgeman.

Tests on British aviation engines using 100-sec. viscosity oils that showed less ring-sticking and sludging than are found with tests on American engines using 120-sec. viscosity oils, were reported by E. O. Petzold, Standard Oil Development Co. Are there data to show that American engines could not use 100-sec. viscosity oils?, he asked.

"Possibly the farther pasture looks greener," replied S. D. Heron, Ethyl Gasoline Corp., to Mr. Petzold's question, explaining that British engines cruise at lower specific horsepowers and throw less oil to the cylinder walls.

Answering Mr. Neely's question, Dr. Bridgeman qualified that he did not mean to imply that stability was the most important problem, but he feels sure that it is one of the important problems.

Many Tests Seen in Bureau of Standards Tour

Laboratory tests, embracing virtually the entire range of those employed in aviation engineering, were observed by the 120 members and guests that took advantage of the invitation of the National Bureau of Standards to inspect its laboratories.

Visitors were divided into two groups: those interested especially in powerplants and those who elected to see the laboratories for testing aircraft structures and materials. Among the 8 laboratories visited by the powerplant group was that employing the apparatus used by Dr. Bridgeman in the investigation on oil stability reported in his paper that morning. The aircraft materials and structures group also had

Gets Manly Medal

Raymond W. Young, (*left*) Wright Aeronautical Corp., receives the Manly Memorial Medal for 1936 from Dr. George W. Lewis, chairman of the Committee for Awards, at the banquet climaxing the National Aeronautic Meeting. Mr. Young's paper: "Air-Cooled Radial Aircraft-Engine Performance Possibilities," was adjudged "the best paper on aeronautic powerplants presented at a meeting of the Society or its Sections during the calendar year." The paper was presented at the 1936 Annual Meeting.

the opportunity to see in operation a wind tunnel and apparatus similar to that used in obtaining data reported in the paper: "Laminar Turbulent Boundary Layers as Affecting Practical Aerodynamics," by E. N. Jacobs, National Advisory Committee for Aeronautics. Some of the other laboratories visited were the engine altitude laboratory, dynamometer testing laboratory, engine-parts inspection, engine-wear investigation, extreme-pressure lubricants investigation, aeronautic instruments, alloy weathering, vibration testing, torsion tests of tubes, and wing beams under applied loads.

Vibration Papers Received Enthusiastically

Measurement of vibration in airplanes need no longer be confined to the laboratory or the ground – it can now be determined in flight on any part of the airplane according to the paper: "Measurement of Vibration in Flight," by Dr. C. S. Draper and G. P. Bentley, Massachusetts Institute of Technology, and H. H. Willis, Sperry Gyroscope Co., Inc. This paper was read to over 200 listeners by Dr. Draper to open the Vibration Session chairmanned by Dr. S. J. Zand, Sperry Gyroscope Co., Inc. The influence of vibration in propeller design was covered in the second paper: "The Vibration Problem in Propeller Design," by F. W. Caldwell, Hamilton Standard Propeller Co.

The apparatus described in our paper is the result of a cooperative research program carried out by the Bureau of Aeronautics of the Navy and the Massachusetts Institute of Technology, Dr. Draper explained. The Sperry Gyroscope Co., Inc., also has contributed new items that extend the capabilities of the apparatus, he added.

"In its essentials the apparatus consists of a number of electrical pickup units that operate a central amplifying and recording unit. Each pickup is especially adapted to the type of vibration that it is intended to measure and is made so small that it does not appreciably affect the vibration characteristics of the member to which it is attached rigidly. By using a number of systematically placed pickups, all the necessary vibration information on an airplane can be recorded during a few short flights."

Aided by slides Dr. Draper then described the apparatus in detail – its two types of electromagnetic pickups for linear and torsional measurement with their seismic elements, provisions for the measurement of strains, the amplifier, and oscillograph. In conclusion he showed how the apparatus was calibrated against vibrations of known amplitude and frequency.

In written discussion, Harold Caminez recommended that strains be always calculated or measured along with amplitudes of vibration as an item of major importance. Drawing from experience in engine design, he told of how vibration amplitude on a crankshaft system had been decreased by stiffening the propeller shaft but the calculations showed that the vibration torque at the propeller had actually been increased. In conclusion, he opined that smoother-running engines will be demanded of airplanes just as they were of automobiles, and that elimination of vibration should be stressed in airplane-engine design even though it means a slight increase in weight.

Vibration and Structural Failures

Speaking in behalf of the airplane designers working on vibration problems, T. P. Wright, Curtiss-Wright Corp., stated that the likelihood of structural failure increases as vibration goes up, and that the apparatus described will help to tell what the vibrations are so that they can be controlled.

"Even with modern methods of measurement such as the apparatus described, vibration problems are not so easy to solve," contends Dr. T. Theodorsen, National Advisory Committee for Aeronautics, "as six quantities must be measured at every point and every speed."

"We are more interested in measuring strains than amplitudes at the Bureau," contributed Dr. L. B. Tuckerman, National Bureau of Standards. He then went on to explain his conceptions of strain-gage design, pointing out that the gage shown in the paper read by Dr. Draper seemed to be unbalanced.

In reply Dr. Draper explained that the design of the strain gages used were inspired by Dr. Tuckerman himself, and that the final instruments were of better design than the rough sketch shown on the screen would indicate.

"The present trend toward very large powerplants in aircraft will lead to a very great increase in propeller weights if the present design practice is adhered to," predicts F. W. Caldwell in his paper: "The Vibration Problem in Propeller Design," as read by C. H. Chatfield, United Aircraft Corp. "These weights are apt to be so great," he continued, "that it will no longed be good practice to ask the propeller designer to fit a propeller to an independently developed engine and airplane combination, since the overall weight probably will be favored by a design that will permit favorable conditions for the propeller.

"Whether the propeller will be one of very great diameter with a high reduction from crank speeds, a multiple-blade design of higher rotational speed, or some type of counter-rotating propeller," he concluded, "it appears very probable that it will be most advantageous to insulate the propeller from the engine as thoroughly as possible."

With the help of slides, studies in propeller vibration were described, giving the historical background, sources of excita-

tion, damping, methods of measuring stress, and the properties of the various materials used, to conclude the paper.

Recalling his experiments at Langley Field, Dr. Theodorsen told of investigations on the symmetrical and unsymmetrical modes and the calculation of centrifugal force. Using a miniature propeller ten times reduced enclosed in a protective tube, he explained how he had established his coefficients.

As a tribute to the quality of the papers presented, Dr. Zand closed the discussion by a quotation of Lord Kelvin's: "If you can measure it, you know something of what you speak."

Moving pictures of wind tunnels and aeronautical laboratories in Germany, Italy, and England were shown following the close of the Vibration Session. These films were prepared by, and shown through the courtesy of, the Institute of Aeronautical Sciences. Explanatory comments were contributed by Major Lester D. Gardner of that Institute.

Varied Program in Aircraft Design Session

First taking up the interior appointments of transport land planes, next surveying French aircraft engines and propellers, and concluding with a discussion of the airport designer's problems, interest at the Aircraft Design Session was maintained at a high level. Discussion was directed by H. J. E. Reid, National Advisory Committee for Aeronautics, session chairman. The last two papers were presented under the sponsorship of the Aeronautics Division of the A.S.M.E.

"The passenger has now become a more important revenue factor than either mail or express, and improvement in passenger comfort certainly will cause an increase in passenger volume," stated H. O. West, United Air Lines Transport Corp., in his paper: "Interior Finish and Arrangement of Transport Airplanes," as read by R. D. Kelly, also of United Air Lines Transport Corp. More comfortable, adjustable chairs, steam heat, soundproofing, and more elaborate meals are some of the facilities provided, he reported.

In designing sleeper planes along the same general lines as Pullman cars, Mr. West told of the problems involved such as that of the reduced load factor for sleepers caused by the fact that only two can be carried in a section at night where four can be carried during the day.

Referring to the statement that soundproofing materials absorb moisture, Dr. Stephen J. Zand, Sperry Gyroscope Co., Inc., told of some tests made on material that showed moisture absorption between 4 and 8 per cent.

"Soundproofing is slightly acid," agreed Dr. Zand, "but the glues with which it is applied are alkaline, making the result neutral. Some color schemes have very bad effects, he reported, citing European tests that showed that, in planes decorated in red, silver, and gold, there was a greater tendency for passengers to become ill.

"The majority of land-plane features described in Mr. West's paper have been in service on China Clippers for a year," claimed L. C. McCarty, Jr., Glenn L. Martin Co., mentioning heated cargo compartments, automatic controlled heat, and removable soundproofing as examples. Others discussing Mr. West's paper included B. C. Boulton, Glenn L. Martin Co., and G. T. Stanton, Electrical Research Products.

Many of our so-called modern developments in aircraft engines and propellers go back to pre-War times in France, according to Henry Lowe Brownback, consulting engineer, in his paper: "Design Trends in French Aircraft Engines and Propellers." "In order to understand these design trends," he explained, one must consider carefully the economic and technical factors, "which largely govern design."

French inventive ability, the ever-present imminence of war, and their lack of intensified manufacturing organization are some of these important factors that have controlled design, he specified. Thus military aircraft are of primary importance, and commercial planes, secondary in France.

Speeds of French military aircraft are so great, Mr. Brownback pointed out, that ordinary machine guns with their short ranges are just about useless, and 20 to 23 mm. cannons are now being used which fire through the propeller shaft.

Drawing from experience in France as far back as 1909, R. W. A. Brewer pointed out the encouragement given to individual designers to produce individual designs by the French Government and others, and deplored the lack of such encouragement in this country.

"To discuss some of the problems of the airport designer that are the result of developments in aircraft brought about by aeronautical engineers," was the object of the paper: "Design Trends as Affecting Ground Facilities," by L. L. Odell, Pan American Airways, Inc.

"Where are we going? Will airplanes ever stop getting bigger?" Mr. Odell asked, explaining that more permanency is expected on the ground than in the air. He recalled that many of the original flying fields of a "meadow, a barn, and a grease monkey," probably would not accommodate the tail surfaces of modern planes.

Land areas also bothered Mr. Odell: "If we need airports two miles square, where are we going to get them?" he asked. Handling, forming, and maintenance of the metal parts of modern planes are requiring more and more hangar space and more highly trained personnel, he pointed out.

To show that he had one good method of coping with these uncertainties, Mr. Odell described and sketched an expansible hangar that will permit enlarging the building in two directions if required by future planes. Three of these hangars are about to be built, he announced.

Quoting I. I. Sikorsky's prediction at a meeting in New York last year, Mr. Boulton stated that a seaplane weighing 1,000,000 lb. was technically possible. "But not economically so," believes Mr. Boulton, giving as his prophecy as the largest for some time to come, 150,000 lb. weight, about 275-ft. span, and 40 to 45 ft. high tail surfaces. "Frequency of service will limit size," contributed Mr. McCarty. Agreeing with Mr. McCarty on the point that frequent service will limit the need for great size, H. D. Fowler, Glenn L. Martin Co., added that a plane of given weight will be able to carry considerably more passengers in the future.

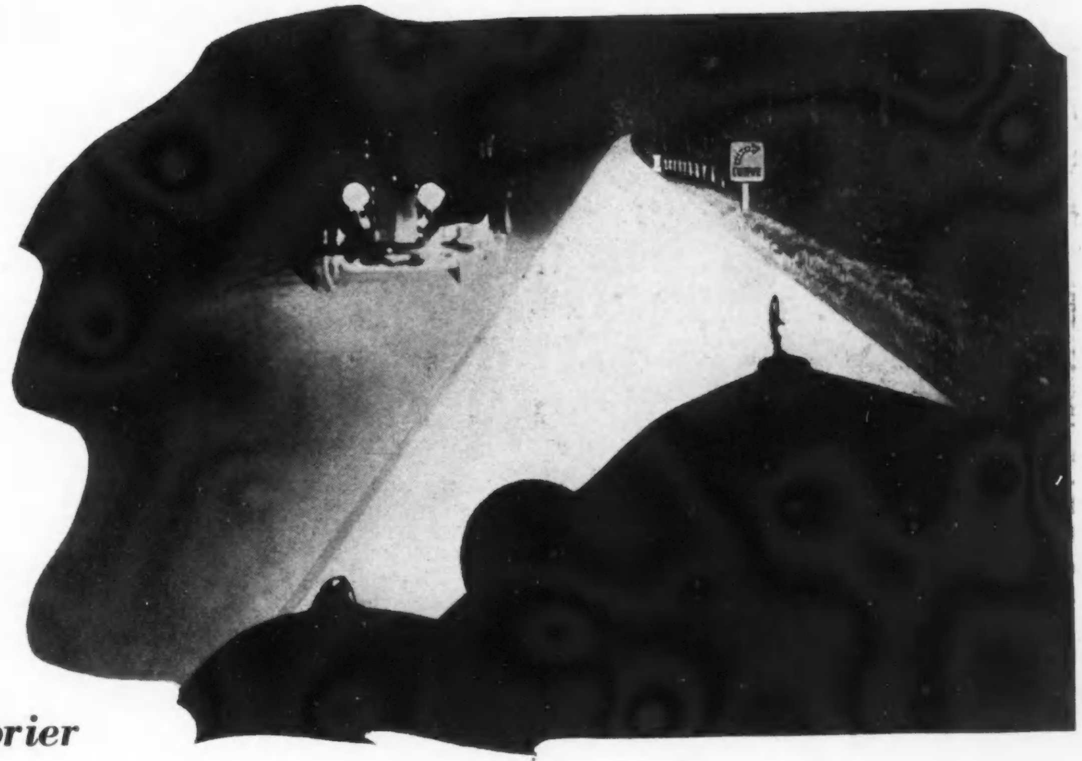
Mr. Odell's future picture was more dramatic than the others: "In ten years aircraft will look different than they do now; surface transportation will be limited to bulk commodities only, all other transportation will be in the air."

Engine Session Concentrates on Three Parts

Carburetors, fins, and reduction gears were dissected in three papers on these subjects in the first engine session of which A. T. Gregory, Ranger Engineering Corp., was chairman. The first entitled: "Carburetion of Engines for Long-Range Flight," by W. L. Losson, Wright Aeronautical Corp., told of the carburetor technique of getting minimum fuel consumption on long flights with safety. How the best compromise was obtained between theoretical design of metal fins and the limitations imposed by manufacturing and service requirements, was explained in the second paper: "The Design of Metal Fins for Air-Cooled Engines," by Arnold E.

(Continued on page 25)

Summer Meeting



May

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9

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FEATURE TOPICS

Headlights **. . . Safety . . . Diesel Engines . . . Fuels . . .** ***Lubricants*** **. . . Trucks . . .** ***Maintenance*** **. . . Passenger Cars . . . Bodies . . . Aircraft Engines . . .** ***Trailers*** **. . . and that's not all . . .**

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TWO BIG

April 21-23
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SAE National Tractor Meeting

Under Auspices of Tractor & Industrial Power Equipment Activity

PROGRAM

Wednesday, April 21

9:30 A.M. **A. G. Marshall, *Chairman***

(*Sponsor: Fuels & Lubricants Activity*)

Crankcase Ventilation and Sludge – W. W. LOWTHER, *Donaldson Co., Inc.*

Effect of Addition Agents in Lubricating Oil on Piston and Ring Performance – C. M. LARSON, *Sinclair Refining Co.*

1.00 P.M. **Luncheon**

As Guests of Caterpillar Tractor Co.

2:00 P.M. **J. M. Davies, *Chairman***

Plant Visit and Demonstration

Thursday, April 22

9:30 A.M. **A. W. Pope, Jr. *Chairman***

(*Sponsor: Diesel Engine Activity*)

Diesel Engines for Agricultural Purposes – M. J. MURPHY, *Murphy Diesel Co.*

Fuel Injection Equipment – H. C. EDWARDS, *Timken Roller Bearing Co.*

2:00 P.M. **J. M. Davies, *Chairman***

Plant Visit and Demonstration

Friday, April 23

9:30 A.M. **L. B. Sperry, *Chairman***

Resistance Electric Welding – E. A. MALLETT, *Taylor-Winfield Corp.*

Some Factors Affecting Design and Performance of Diesel Fuel Injection Equipment – G. C. RIEGEL, *Caterpillar Tractor Co.*

2:00 P.M. **J. B. Fisher, *Chairman***

Tractor Activity Business Session (VICE-PRESIDENT ELMER MCCORMICK to preside)

Servicing Multi-Cylinder Diesel Engines (with motion pictures) – R. J. KRETZ, *International Harvester Co.*

MEETINGS

Transportation & Maintenance

SAE Regional

Public Utility Fleet Meeting

April 15 & 16 Hotel Belvedere Baltimore

PROGRAM

Thursday, April 15

10:00 A.M. **Adrian Hughes,** ***Chairman***

Oil Filters in Public Utility Fleet Operation – PROF. J. I. CLOWER – *Virginia Polytechnic Institute*

2:00 P.M. A. H. Bishop, ***Chairman***

Utility Trucks, Cabs, Bodies and Auxiliary Equipment – T. C. SMITH – *American Telephone & Telegraph Co.*

6:30 P.M. R. C. Hall, ***Chairman***

"Utilities" Dinner

ALLEN W. MORTON, *Toastmaster*

As the SAE Advances – JOHN A. C. WARNER, *Society of Automotive Engineers*

How the SAE Can Be Helpful to the Public Utility Operators – J. G. HOLTZCLAW, *Virginia Electric & Power Co.*

Friday, April 16

10:00 A.M. W. H. Beck, ***Chairman***

Executive Control of Public Utility Fleet Operations – F. B. FLAHIVE, *Columbia Gas & Electric Co.*

Single-Property Fleet Supervision – W. R. POLLARD, *Georgia Power Co.*

12:30 P.M. **J. R. Sherwood,** ***Chairman***

"Safety" Luncheon

A Study of the Safe Driver – J. W. LORD, *Atlantic Refining Co.*

2:30 P.M. L. W. Shank, ***Chairman***

Economy Symposium

Ten minute presentations on the following topics:

Throttle Stops – O. A. AXELSON, *Columbia Gas & Electric Co.*

Results of Non-Changing Motor Oil – E. W. JAHN, *Consolidated Gas, Electric Light & Power Co.*

Pooling of Passenger Car Equipment; and Night Maintenance – J. Y. RAY, *Virginia Electric & Power Co.*

Pole-Trailer Brakes – DANIEL DURIE, *West Penn Power Co.*

Service and Maintenance Practice in Utility Fleets – C. D. PEEBLES, *Carolina Power & Electric Co.*

COME to the DINNER!

Thursday, April 15

Get your tickets early

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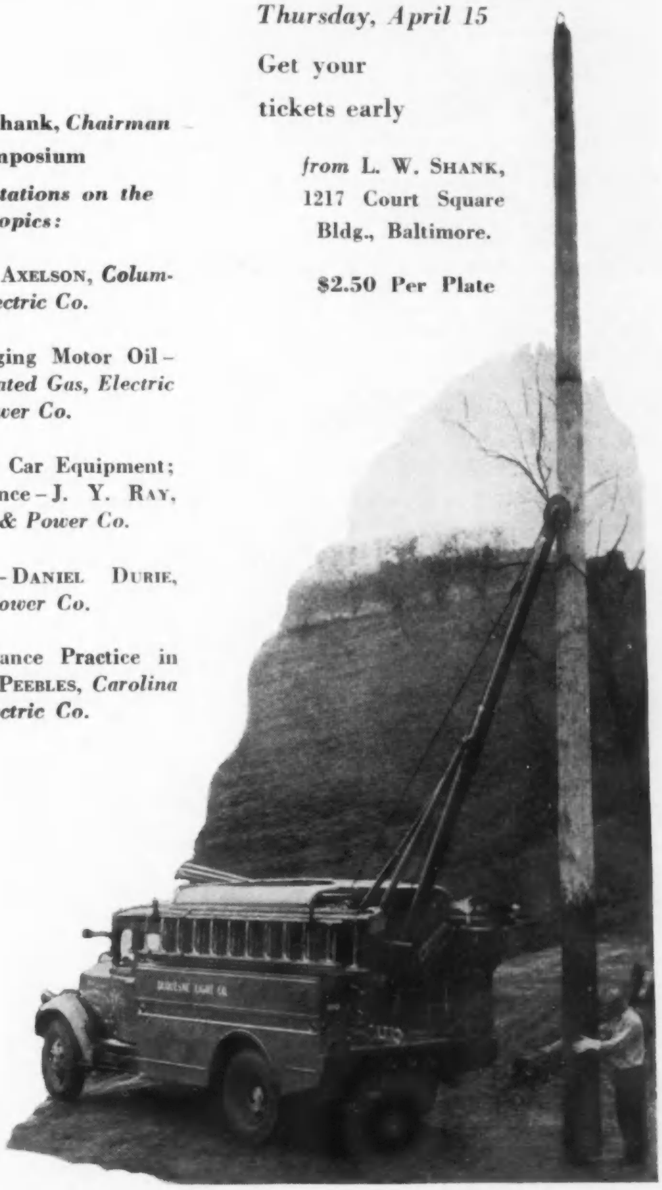

News of the Society

Agler Talks on Fleet Maintenance; Maxwell on Diesel-Fuel Injection

• No. California

TRUCK maintenance and Diesel-fuel-injection equipment shared the spotlight when the Northern California Section met March 9 at San Francisco's Bellevue Hotel. "Vehicle Maintenance By Utilization of Special Instrumentation," was discussed by the first speaker, W. B. Agler, automotive department, Tidewater Associated Oil Co. He was followed by C. R. Maxwell, experimental laboratory, Caterpillar Tractor Co., whose topic was "Interesting Phases Disclosed in Diesel-Fuel-Injection-Equipment Development." Both speakers were introduced by Meeting Chairman J. M. Evans.

Mr. Agler spoke particularly of his company's fleet, which is maintained and serviced largely by contract garages, although some of the work is done in company-owned shops. He explained that all contract garages are under the supervision of the company's regional and district supervisors. Other personnel, he said, is assigned to inspect the vehicles, traveling from shop to shop. The major portion of his talk was devoted to this latter group and the instruments used by them.

They may be called efficiency men, he said, because they are supplied with precision instruments for tests and necessary equipment to make whatever adjustments or repairs that they find necessary. Their particular function is to increase engine and fuel efficiency, he said, explaining that their prearranged procedure for conducting tests is as follows: ignition, compression pressures, spark-plugs, fuel-pump pressure, back pressure, in the exhaust system, restriction of air cleaner, dragging brakes, efficiency of brakes, tire pressures and carburetion. He described the method and instruments used in each test.

In conclusion he said, "Formulation of a systematic tune-up plan combined with proper instrumentation and qualified personnel is conducive of greater operating economies bound to reflect a substantial saving over a period of years."

Discussion of this paper brought out a number of interesting points, particularly those of S. B. Shaw, Pacific Gas & Electric Co., who spoke on the tune-up procedure followed by his company. He remarked on the difficulty of keeping exhaust-gas analyzers in good working order and the prevalence of deficient ignition equipment, even on new cars, particularly in connection with condensers. Some types of vacuum spark control, he added, function poorly due to condensation of gasoline in the control diaphragm, which is located so that inspection is difficult.

Turning from the conventional gasoline vehicle to the Diesel field, Mr. Maxwell introduced his paper by remarking that Diesel injection systems are complex by reason of the several essential functions which they must carry out with precision and which must not vary appreciably with engine speed. These, he said, include fuel injection, atomization, directing of injected fuel, timing and rate of injection.

Continuing, Mr. Maxwell described several machines used by the Caterpillar company to observe the behavior of the injection system. The first, termed a spray machine, is composed of a fuel pump of variable speed, a spray valve in a partially open chamber and a neon stroboscopic light. By means of this apparatus the fuel

(*Continued on page* 38)

President Woolson Visits Five Sections

Visiting New England, Southern New England, Metropolitan, Philadelphia and Cleveland Sections last month, SAE President Harry T. Woolson spoke of the Society as a world-wide organization and declared that its aim is greater engineering usefulness; usefulness to its members, to its industry and to the nation. Mr. Woolson was accompanied by SAE General Manager John A. C. Warner, who likewise addressed the Sections, choosing as his theme, "As the SAE Advances."

Mr. Woolson observed that while plants located within 80 or 90 miles of Detroit ship approximately 90 per cent of the motor-vehicles produced in this country, they are dependent upon nearly every state of the Union for raw materials entering their construction, such as steel, rubber, brass, and textiles, wholly or partially fabricated. He added that for each dollar spent in an automobile factory about three dollars is spent elsewhere.

He also emphasized that these factories centering around Detroit are dependent on the vast markets of the country to operate on a mass-production basis and that the engineers in these plants depend largely upon experience obtained from field operation to improve their products year after year. He said to his audiences, "You have a wonderful opportunity to check the cars produced in the middle west for endurance and to point out their weaknesses. We at the factories welcome constructive criticism from operation and maintenance engineers as we are continually on the trail of faults, that they may be corrected. The complete process of producing automobiles is a great national cooperative job."

Mr. Woolson said that in all engineering design engineers are continually required to face compromises. He illustrated this by what he termed "the battle of the grilles" in which automotive engineers engage each year. The compromise in this case, according to Mr. Woolson, is between efficiency to cool an engine and appearance to promote sales. He added that to further complicate the matter the final design must be one that can be produced at a reasonable cost.

At each section Mr. Warner gave what he termed a "short short story" in which he told how the scope and work of the Society moves as rapidly and changes as often as does automobile design. "The SAE is advancing," he said, "advancing on every automotive front toward the ultimate in automotive engineering!" To illustrate the Society's progress Mr. Warner outlined its program of national and regional meetings and gave some of the highlights of activity in the SAE's 59 major technical and administrative committees.

(*News of the Society continued on page* 32)

Field Editors

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O. A. Hansen

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Warren B. Hastings

Chicago
Austin W. Stromberg

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William G. Piwonka

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Harlow Hyde

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No Appointment

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Max Hofmann

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Philip Cogswell

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Henry Jennings

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Murray Fahnestock

St. Louis
C. T. Schaefer

So. California
W. G. Chamberlin

So. New England
John G. Lee

Syracuse
No Appointment

Washington
R. E. Plimpton

SAE National Aeronautic Meeting

(*Continued from page* 20)

"Food for thought" in the form of a survey of the rapid expansion in European aircraft production, was brought to the banquet by its principal speaker, Arthur Nutt *(left)*. His speech reported visits to plants in principal European countries.

Dr. Fred D. Fagg, Jr., *(right)* recently appointed Director of Air Commerce, pleads for an open-minded approach to the solution of aviation's problems at the banquet. This was his first talk to engineers since joining the Department of Commerce.

Photos by Stephen J. Zand

Biermann, National Advisory Committee for Aeronautics. Seven types of reduction gears were described in the final paper of the session: "Aircraft Engine Reduction Gears," by Ford L. Prescott, Materiel Division, U. S. Army Air Corps.

"The payload of a fifty-ton airplane can be nearly doubled if the average cruising consumption of the engines is reduced from 0.43 to 0.41 lb. per b.hp-hr.," claims Mr. Losson. "However," he cautioned, "the fact that the engines will operate with the leaner mixture is of no advantage unless the fuel flow is controlled accurately."

Mr. Losson listed four types of carburetors for long-range cruising ranging from fully automatic compensation to manual mixture control operated in conjunction with a mixture indicator.

In a rapid-fire exchange, W. W. Symington, Jr., Glenn L. Martin Co., discussed with Mr. Losson the problem of determining the specific fuel consumption desired at different altitudes in long-range flight. Mr. Losson indicated that some of the data could be predetermined but that the final answer must be found in flight tests.

"It is very desirable to have very thin, closely spaced fins of considerable width," stated Mr. Biermann introducing his paper. "Past experience, however," he continued, "has shown that it is difficult to machine or to cast fins having these characteristics."

Significant conclusions reported by Mr. Biermann in his investigations of fins for one particular diameter of cylinder are that "a considerable improvement in the heat-transfer characteristics of conventional aluminum fins is possible by correctly proportioning fin dimensions" and that "aluminum fins will transfer more than 2¼ times as much heat as steel fins for the same weight and pressure drop."

In written discussion, Kenneth Campbell, Wright Aeronautical Corp., believes that minimum allowable baffle-pressure drop is the best criterion for defining optimum fin design.

"The added weight and complication of reduction gears is necessary," explained Ford L. Prescott in his paper on this subject as read by R. M. Hazen, Allison Engineering Co., "because the crankshaft speed far exceeds the economical propeller speed with present-day engine designs. However," he continued, "if the reduction-gear ratio and propeller diameter are increased to the optimum value from the standpoint of propulsive efficiency, the weight in some cases is prohibitive and a compromise is necessary in selecting the reduction-gear ratio."

Additional details were requested of Mr. Prescott by E. V. Farrar, Wright Aeronautical Corp., in written discussion read by A. L. Beall, Wright Aeronautical Corp.

Whether or not flexibility is desirable in the propeller connection with planetary-type reduction gears was the subject of spirited discussion of Mr. Prescott's paper. Thomas Barish, Marlin-Rockwell Corp., felt that such flexibility was undesirable because it affected the critical torsional vibration periods. That the vibration periods were so affected, was conceded by Val Cronstedt, Aviation Mfg. Co., but he suggested that these torsional frequencies could be shifted out of the operating-speed range. Arthur Nutt, Wright Aeronautical Corp., on the other hand, believes that the propeller manufacturers want such a flexible connection.

Brisk Discussion in Final Engine Session

To obtain more engine power there evidently is more to be considered than merely opening the throttle wider, stated Val Cronstedt, Aviation Mfg. Co., session chairman, to open the second Engine Session.

The first paper, "Flexible Exhaust-Valve Seats," by S. D. Heron, Ethyl Gasoline Corp., and A. L. Beall, Wright Aeronautical Corp., was read by Mr. Heron. He stated that, although some cylinder designs are attractive due to compactness and ease of securing large valve area, they are known to be subject to exhaust-valve-seat distortion. The investigation reported in the paper was carried out to determine whether the difficulties resulting from distortion can be overcome by flexibility in the valve head or valve seat, he announced.

In discussion following, A. T. Colwell, Thompson Products, Inc., stated that shallow and wide valve seat inserts gave poor results, whereas narrow and deep inserts gave good results. It also was stated that seats faced with Stellite gave good performance owing to their non-corrosiveness.

"Flexible valve seats," according to Arthur Nutt, Wright Aeronautical Corp., "may give four-valve cylinder heads a new lease on life." Two valves, he added, were used in this country mainly on account of seat distortion accompanying the four-valve type. The two-valve type of heads give from 400 to 500 hr. of satisfactory service provided no lead is used, he specified.

A. G. Elliot, Rolls-Royce, Ltd., criticized the flexible seats on the basis of: (1) increased heat-absorption area in the combustion-chamber; (2) restriction of the valve diameter; (3) increased heat flow up the valve stem which would cause carbon formation on the valve stem and springs.

In his conclusion, Mr. Heron remarked that there was nothing to be gained by using flexible valve-seat inserts in cases where distortion did not occur. Furthermore, when using flexible valve seats it is necessary to obtain all the internal valve cooling possible, he cautioned.

Other discussers were: C. D. Waldron, National Advisory Committee for Aeronautics; Harold Caminez, and A. L. Beall, the co-author.

In introducing his paper on "The Determination of Ratings for Transport Aircraft Engines," R. F. Gagg, Wright Aeronautical Corp., stated that the objective in choosing an engine rating is "to establish the limiting values in the operating procedure which permit a maximum of utility in power output and economy of fuel consistent with requirements for safety and durability."

In his paper Mr. Gagg pointed out the importance of design calculations, of single-cylinder laboratory tests, and of dynamometer calibrations of the engine performance.

Furthermore, he stated, after the engine ratings are determined on the basis of stress values, it becomes necessary to recheck the fuel consumption and detonation performance of the engine with the fuel tentatively selected for use.

Among those who discussed Mr. Gagg's paper were: F. C. Mock, Bendix Products Corp., Harold Caminez, and Charles Froesch, Eastern Airlines, North American Aviation, Inc., who submitted a written discussion which was read by A. L. Beall.

The need for controlled oil circulation governed by the viscosity rather than by the oil temperature was pointed out by Weldon Worth, U. S. Army Air Corps, in his paper, "Lubrication and Cooling Problems of Aircraft Engines." Control of the oil temperature by means of the oil flow was more satisfactory than by the use of shutters on the radiator, he reported.

Mr. Worth described the oil-dilution system used for facilitating the starting of cold engines and which is now undergoing tests by the Air Corps. In this system he explained how provision is made for thinning the lubricating oil by the addition of gasoline prior to stopping the engine.

Among those who discussed this paper were: W. H. Robotham, Rolls-Royce, Ltd., R. M. Hazen, Allison Engineering Co., S. D. Heron, R. F. Gagg, Kenneth Campbell, Wright Aeronautical Corp., L. P. Saunders, Harrison Radiator Corp., A. G. Elliot, and Arthur Nutt. In reply to their questions, Mr. Worth stated that the hazard created by gas in the crankcase was not serious, as the mixture normally found in the crankcase was over-rich for combustion. There apparently was no undue wear caused by lead in the oil or caused by using a small quantity of oil very severely for a short time rather than a large quantity less severely for a longer period, he added. In normal operation, he concluded, about 2 qt. of gasoline are used for oil dilution, and the progress in diluting the oil can be observed on the oil pressure gage.

Two Aerodynamic Problems Debated

Pointing out that the purpose of his paper was to show "not what is known, but rather to emphasize that which is not known," a résumé of the researches leading to the realization of the importance of the boundary-layer phenomena, especially the transition from laminar to turbulent flow, was presented by E. N. Jacobs, National Advisory Committee for Aeronautics, in the first paper at the Practical Aerodynamic Problems Session, "Laminar and Turbulent Boundary Layers as Affecting Practical Aerodynamics." Supplementing his talk with slides and motion pictures of the boundary layer over airfoils and flat plates, he indicated the general nature of the phenomenon and emphasized the lack of knowledge concerning the transition from laminar to turbulent flow. Peter Altman, University of Detroit, presided.

Expressing some concern as to whether Mr. Jacobs was optimistic or pessimistic in regard to promise of future aerodynamic gains, Dr. Max M. Munk assured the session of his own optimism in this respect. He urged a continuation of this research as holding forth worthwhile promise. T. P. Wright, Curtiss-Wright Corp., presented some rough figures on the possible gains to be expected and expressed an optimistic outlook. C. H. Chatfield, United Aircraft Corp., asked about the importance of roughness over the aft portion of airfoil.

In reply, Mr. Jacobs reassured Dr. Munk of his optimism and pointed out the importance of reproducing flight conditions for the proper solution of the problem. This method necessitates equipment whereby full-scale Reynolds Numbers and low turbulence can be obtained, he indicated. Mr. Altman raised the question of double-peak lift curves and the influence of the type of lift-curve peak in design.

H. D. Fowler, Glenn L. Martin Co., discussed the merits of the flap bearing his name and urged its use as a solution of the difficulties in present-day design in the session's second paper: "The Practical Application of Fowler Flaps." He urged also that it not be discarded because of mechanical difficulties and emphasized the need of allowing for the flap in the basic design rather than the arbitrary application of a flap to an already established design. He discussed at some length the merits of this particular flap in the performance of its several functions.

F. E. Weick, Engineering and Research Corp., opened the discussion by raising a question as to the exclusive merit of the particular flap under discussion, indicating he did agree that in many functions it was superior to other types of flaps. T. P. Wright, reading from written discussion, emphasized the author's warning that a design should not be discarded because of mechanical difficulties.

Papers Available in Mimeographed Form

UNTIL current supplies are exhausted, copies of the papers listed are available in mimeographed form at a cost of 25 cents per copy to members; and at 50 cents per copy to non-members (plus 2% sales tax on those delivered in New York City). Orders should specify the name of the author as well as the title of the paper desired.

Orders must be accompanied by remittance and should be addressed to Sessions Secretary, Society of Automotive Engineers, 29 West 39th St., New York, N. Y.

Aitken, Murray
Buses for Mass Transportation

Alden, C. R.
Development of High Speed Diesel Engine Fuel Injection Pumps

Anthony, C. G.
Automotive High-Speed Diesel Engine in Heavy-Duty Transport

Antonsen, Anker K.
Machining of Large Cast Diesel Engine Crankshafts

Bachman, B. B.
Notes on Applying Diesel Engines to Trucks

Bailey, C. W.
Parcel Delivery

Banzi, J.
Midget Racing Cars

Barnard, D. P.
What an Octane Number is Worth in the Air

Barrie, A. A.
Modern Aids to Navigation

Bartholomew, Earl
Tractor Engine Fuels – A Theoretical Analysis and Practical Test Results in the Laboratory and in the Field

Beall, A. L.
A Brief Analysis of the Automotive Lubrication System

Beard, M. Gould
Problems in Testing of Airplanes for Airline Service

Bedford, Lieut. S. R.
Application of Small Diesel Engines in the Navy

Benninghoff, W. E.
Tocco Hardening

Berg, Roy E.
Performance Characteristics of Friction Materials and Their Evaluation

Biermann, A. E.
The Design of Metal Fins for Air-Cooled Engines

Blackwood, A. J.
Some Recent Observations on American and European High Speed Diesels

Boyer, R. L.
Constant Pressure Fuel Injection for Diesel Engines

Brown, Howard D.
Modern Body Structure and the Service Problem

Brown, L. H.
Economics of Streamlining in Heavy Transportation

Brown, R. N.
Tooling of the Packard 120 Cylinder Block

Brownback, H. L.
Design Trends in French Aircraft Engines and Propellers

Cadwell, S. M.
Recent Developments in the Rubber Industry

Caldwell, F. W.
The Vibration Problem in Propeller Design

Campbell, A. F.
Economic Place of Automotive Oil Engines

Chesnutt, R C.
Diesel or Gasoline – Which Engine Will You Have?

Christmas, Major J. K.
Mechanization and Automotive Ordnance

Churchill, W. W.
How To Maintain a Fleet of Buses and Trucks Economically

Damon, R. S.
Problems in Air Line Operation

Davis, Harry G.
The Cavalcade of Farm Mechanization

DeMott, R. H.
Sales Engineering

Drake, H. W.
The Future of Highway Transportation

Draper, C. S., Bentley, G. P., and Willis, H. H.
Measurement of Vibration in Flight

DuBois, R. N., and Cronstedt, Val
High Output – And How?

Everett, H. A., and Mikita, J. J.
The Effect of Detonation on Oil Consumption

Foresman, S. T.
The Influence of Balancing on Today's Automobile

Fowler, H. D.
The Practical Application of Fowler Flaps

Gagg, R. F.
Determination of Service Ratings for Transport Aircraft Engines

Gazley, R. C.
Factory Facilities and Federal Regulations

Good, Lt. Com. R. F.
Cetane Numbers, Life Size

Gordon, A. B.
Reclamation of Automotive Parts

Gritsch, J. A.
The Place of the Diesel Engine in Highway Transportation

Halsey, Maxwell
Building Safety and Facility into the Roadway

Hartney, Col. H. E.
Safety in Air Transport

Heron, S. D., and Beall, A. L.
Flexible Exhaust Valve Seats

Herrington, A. W.
Variable Transportation Problems of the World

Hoey, W. B.
Thermo Setting Molding Practice

Holaday, W. M., and Moore, G. T.
Development of an Altitude Knock Test Method

Houghton, Howard D.
Designing for the Use of Aluminum Alloy Forgings and Extrusions in Aircraft Production

Huckle, M. S.
Heat Rejection from Diesel Engines

Jacobsen, C. H.
Highway Transport Regulation and Legislation

Jehle, Ferdinand
Application of Your College Training to Engineering

Johnson, S., Jr.
Operating the Modern Vehicle With Air Brakes and Air Control

Johnson, S., Jr.
Sales Engineering

Jordan, H. E., and Hamilton, W. P.
Air Vs. Highway Transportation Maintenance

Jouett, J. H.
Designing and Building for the Commercial Aircraft Market

Killick, V. W.
Can We Build Automobiles to Keep Drivers Out of Trouble

Kishline, F. F.
The Development of Superchargers and High Compression Engines

(Continued on Page 42)

About SAE Members:

H. J. Carmichael, vice-president and general manager, General Motors of Canada, Ltd., has been elected vice-president of the Canadian Automobile Chamber of Commerce.

H. W. Linneen, formerly assistant district manager of the Sinclair Refining Co., in Chicago, has been transferred to New York, where he has taken up his new duties as assistant manager, domestic lubricating oil sales.

William B. Wheatley, chief test pilot and service manager, Consolidated Aircraft Corp., San Diego, flew as 2nd pilot on one of the 12 Consolidated airboats of the U. S. Navy from North Island, San Diego to Pearl Harbor, T. H., on the mass flight taking place Jan. 28-29. He returned as a passenger on the Hawaii Clipper arriving in Alameda, March 4, continuing to San Diego by air. The flight was made in connection with service work.

D. C. Johns is in the combustion engineering service department of the Gulf Oil Co., Pittsburgh. He was previously district supervisor of that company's automotive oil sales in Toledo.

Robert A. Weinhardt has joined the W. M. Chace Co., Detroit. He will deal particularly with thermostatic bimetal problems of

R. A. Weinhardt
Changes Companies

the automotive industry. Mr. Weinhardt was formerly assistant chief engineer of the Reo Motor Car Co., and had previously been affiliated with Packard, Continental Motors and Cord.

William A. Arthur is with the McLellan Steel Construction Co., Los Angeles. He was formerly president of the National Airport Engineering Co., also in Los Angeles.

Ernest Bennett, supervisor, buildings, vehicles and supplies, Bell Telephone Co. of Canada, with headquarters in Montreal, is in Europe observing transportation and maintenance operation in England, France, Germany and Italy. As chairman of the foreign contact subcommittee of the SAE Transportation and Maintenance Activity he will develop plans for closer contact between the Society and fleet operators in these countries.

P. W. Litchfield, president Goodyear Tire and Rubber Co., recently revealed that researches carried on in the Goodyear laboratories show that tires made of rayon cords may be expected to give, in some instances, four to five times as much mileage as other tires, particularly under high-speed heavy-load conditions.

A. W. Scarratt, formerly chief engineer, automotive engineering, International Harvester

A. W. Scarratt
Advanced

Co., has been appointed assistant to the vice-president of engineering and patents. He joined International Harvester in 1927 from the Hyatt Roller Bearing organization of which he was chief engineer. He was previously chief mechanical engineer of the Minneapolis Steel & Machinery Co., with which he was affiliated from 1914 until 1926.

Maurice Holland, director of the division of engineering and industrial research, National Research Council, will conduct a group of industrial leaders and bankers on a tour of European scientific and research laboratories. This will be the fourth such tour sponsored by the engineering and industrial research division of the Council. The group will sail May 14.

Elmer A. Sperry, Jr., chief engineer, Sperry Products, Inc., is a member of the tour advisory committee.

C. W. Spicer, vice-president, Spicer Manufacturing Corp., Toledo, visited SAE Headquarters March 15. He and Mrs. Spicer had just returned from a vacation trip to California. Visiting the Mardi Gras in New Orleans on the way out, they came back by the way of the Panama Canal, stopping at Panama and Havana.

V. P. Rumely, who had been affiliated with Hudson Motor Car Co., for 21 years, recently resigned his position as division superintendent

V. P. Rumely
To New Field

to join the manufacturing division of Crane Co., in Chicago. At the time of this change Mr. Rumely was chairman of the Detroit Section.

Floyd F. Kishline, Detroit Section's passenger-car vice-president, has been chosen to head the Section's activities for the remainder of the year.

Harold R. LeBlond has been elected president of LeBlond-Schacht Truck Co., Cincinnati. He was formerly secretary-treasurer.

Ralph E. Flanders, president of Jones and Lamson Machine Co., Springfield, Vt., has been appointed to the governing board of the Massachusetts Institute of Technology.

Sherman M. Fairchild, founder and recent president of Fairchild Aviation Corp., has been elected chairman of its board. He will retain the presidency of Fairchild Engine and Airplane Corp., holding company for Fairchild Aircraft Corp. Mr. Fairchild recently announced that a 24-cylinder airplane engine delivering approximately 1000 hp. and permitting the mounting of a rapid-firing cannon is under development by his company.

Edsel B. Ford has been reappointed to the Detroit Arts Commission. His new term will expire in 1941.

W. B. Mayo, former chief engineer of the Ford Motor Co., has been elected chairman of the board of the Huron River Silica Co. Since leaving Ford, Mr. Mayo has been interested in

W. B. Mayo
Back to Glass

the freight transport business. This affiliation with the glass industry recalls the fact that Mr. Mayo is credited with having invented the continuous process for the manufacture of plate glass now being used by the Ford Motor Co. and others.

Herman D. Barkey, previously director, department of aeronautic engineering, Indiana Technical College, Fort Wayne, is in the engineering department of the Curtiss-Wright Airplane Co., Robertson, Mo.

Dr. Ing. Ferdinand Porsche, who is closely associated with the German Auto Union, has designed a small two-cylinder rear-engined car which, it is reported, will be backed by Chancellor Adolf Hitler as a vehicle inexpensive enough to permit its purchase by a large number of Germans and other Europeans hitherto unable to own a car.

At Highway Officials Convention

W. J. Davidson, director, technical section, General Motors Corp., and chairman of the S.A.E. Engineering Relations Committee, and Dr. Miller McClintock, director, Bureau of Street Traffic Research, Harvard University, addressed the Association of Highway Officials of the North Atlantic States at their thirteenth annual convention, New York, Feb. 24-26.

Mr. Davidson's topic was "Motor Vehicles – Their Relationship to the Highways," and that taken by Dr. McClintock was "Safety on the Open Road."

H. C. Mougey, chief chemist, General Motors Corp., was chairman of the committee in charge of the symposium on lubricants at the regional meeting of the American Society for Testing Materials, Chicago, March 3 and 4.

William W. Barnetson, formerly in the Ford Motor Co. tool repair department, Ontario, Canada, has joined the Apollo Magneto Corp., Kingston, N. Y.

L. C. Milburn has resigned as director and vice-president of the Glenn L. Martin Co., Baltimore.

Carl Keas, formerly with the Carnegie-Illinois Steel Corp., south works, Chicago, has joined Russel T. Gray, Inc., industrial advertisers, also in Chicago, as copywriter.

Harold M. Taylor, Firestone Rubber Co.'s Detroit district manager, has been nominated by the Detroit Athletic Club News for "Our Own Hall of Fame," because "he is head man in staging the National Open Golf Tournament next June . . . he is chairman of the D.A.C. bowling committee . . ."

E. N. Klemgard has closed his consulting lubrication engineering business and laboratory at Pullman, Wash., and has joined the Panther Oil & Grease Manufacturing Co., Fort Worth, Texas, as director of manufacturing. Long affiliated with the oil industry, Mr. Klemgard will be concerned chiefly with the development of new lubricating greases and bituminous products and further modernization of the company's Fort Worth grease plant.

Donald Blanchard, secretary of the SAE Engineering Relations Committee, spoke on safety before the Automotive Trade Association Managers in New York, March 1.

O. C. Kreis, who resigned from Studebaker's engineering division recently, has joined the General Motors organization and, late in February, sailed for Germany to take up his new duties at the Corporation's Opel plant.

George H. Townsend has become president and director of M. M. Davis and Son, Inc., Baltimore, builders of sail and motor boats.

M. L. Kerr
Chief Engineer

M. L. Kerr, engineer, Indiana division, White Motor Co., has left Cleveland to become chief engineer of the Garford Truck Co., Marion, Ind.

G. C. R. Kuiper, who was formerly chief engineer of Midland Steel Products Co., has been affiliated with General Motors' Adam Opel Co., Russelsheim, Germany, since Feb. 15.

Ralph F. Ley, formerly sales manager, Truck Tank Manufacturers, Inc., has joined Shand & Jurs Co., Berkeley, Calif., as eastern district manager. He will be located in New York.

Warren A. Taussig is automotive engineer for the Burlington Transportation Co., Chicago.

. . . . At Home and Abroad

W. T. Lutey, who has been superintendent of production standards, Fisher Body Corp., Leeds, Mo., has been transferred to the New Linden, N. J., plant of General Motors Corp. At the time of this transfer Mr. Lutey was secretary-treasurer of the SAE Kansas City Section.

B. F. Jones has been made chief engineer of the Indiana division of White Motor Co. He was previously engineer in the White public works division, Cleveland.

George W. Smith, Jr., formerly vice-president, White Motor Co., Cleveland, and more recently consulting engineer in Cleveland, has affiliated with the American Appraisal Co., as director of the industrial report division. He will be located in New York.

Metrosection Invitation

The Metropolitan Section is extending an invitation to the National Society through the Meetings Committee to hold the 1938 Annual Meeting in New York City, assuring them of their wholehearted interest and cooperation in such an eventuality.

Raymond D. Kelly, formerly in charge of instrument overhaul and testing for United Air Lines Transport Co., at Cheyenne, Wyo., has been transferred to the Chicago division of the company where he is in charge of testing equipment and accessories for plane operations.

Frederick L. Parsons, who has been instructor at the U. S. Diesel Engineering School, Boston, has recently joined the Scintilla Manufacturing Co., Inc., Sidney, N. Y., as draftsman.

W. L. Batt, president, SKF Industries, Philadelphia, sailed for Europe late last month.

Chester C. DePew, formerly with Wright Aeronautical Corp., Paterson, N. J., as engine designer, has joined the Ranger Engineering Corp., Farmingdale, Long Island, N. Y., as design engineer.

Luis De Florez, consulting engineer, New York, has been designated an official timer by the National Aeronautic Association.

Vincent Bendix, president of the Bendix Aviation Corp., will enlarge and modernize the Teterboro, N. J., airport. It is said that special emphasis will be put on facilities for blind landing.

J. R. Hubbard, heretofore captain, U. S. Army, Quartermaster Corps, has been advanced to the commission of major. He is stationed at Governors Island, N. Y.

Leighton W. Rogers has been re-elected president of the Aeronautical Chamber of Commerce of America. Among SAE members on

Leighton W. Rogers
Re-elected

the board of governors are James Murray, G. W. Vaughan, S. M. Fairchild, Charles Marcus, C. L. Lawrance, Maj. E. E. Aldrin, Walter Beech and G. M. Bellanca.

Kwang H. Chang has joined the Diesel engine division of the American Locomotive Co., Auburn, N. Y., as tool designer. He was formerly senior draftsman, City of New York, department of parks, topographical division.

Morris J. Muzzy who was assistant head, engine test department, General Motors Proving Ground, Milford, Mich., has been transferred to the Phoenix Laboratory, operated by the General Motors Sales Corp., at Phoenix, Ariz.

Yoshio Ogawa has opened an office in Los Angeles, as consulting engineer specializing in research and developing automotive and allied products and industrial designing.

John P. Gaty, former liaison engineer, Fairchild Aerial Camera Corp., Woodside, Long Island, N. Y., is now with the Beech Aircraft Corp., Wichita, Kan., as sales manager.

Paul S. Lane, research metallurgist, American Hammered Piston Ring Division, The Koppers Co., Baltimore, Md., will deliver a paper on "Some Experiences with Wear Testing" at the forty-first annual convention of the American Foundrymen's Association, Milwaukee, May 3-7.

Wilson D. Applegate has been advanced to assistant chief engineer by the Wilkening Manufacturing Co. He has been in the engineering department of Wilkening since graduating in mechanical engineering from Drexel Institute in 1934.

At Safety Conference

Eight SAE members are scheduled to take part in the Eighth Annual Convention of the Greater New York Safety Council, New York, April 13-15.

Those participating are: H. H. Kelly, Bureau of Motor Carriers; R. C. Long, Wheels, Inc.; Frank Bailey, Auto Mutual Indemnity Co.; N. M. Aycock, The Texas Co.; Maj. E. E. Aldrin, Standard Oil Development Co.; F. R. Norris, C. F. Burgess Laboratories, Inc.; Dr. Miller McClintock, Bureau of Street and Highway Research. John A. C. Warner, SAE secretary and general manager, is on the General Committee.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Feb. 10, 1937, and Mar. 10, 1937.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

BENNETT, ERNEST (M) general buildings, vehicles and supplies supervisor, Bell Telephone Co. of Canada, Beaver Hall Bldg., Montreal, Quebec, Canada.

BOORD, HARRY W. (A) special representative, American Oil Co., 1301 Grant Bldg., Pittsburgh, Pa.; (mail) 2915 Belrose Ave., South Hills.

BROWNLEE, CLARENCE S. (M) president, charge of sales and engineering, Dickson Gasket Co., Lock Box 1166, Chicago, Ill.

BURKHALTER, ROBERT R. (J) designer, Spicer Mfg. Corp., Toledo, Ohio; (mail) 2019 Wellesley Drive.

CARPENTER, CARROLL E. (A) board and paper division, National Automotive Fibres, Inc., 19925 Hoover Ave., Detroit, Mich.

CRONE, ALFRED F. (A) vice-president, charge of operations, Acme Steel & Malleable Iron Works, Buffalo, N. Y.; Buffalo Brake Beam Co., Lackawanna, N. Y.; (mail) c/o Acme Steel & Malleable Iron Works.

DALZELL, C. W. (M) chief electrical engineer, Heyer Products Co., Inc., 740 Washington Ave., Belleville, N. J.

EDGAR, J. A. (M) research engineer, motor laboratory, Shell Oil Co., Martinez, Calif.

FISHER, GERALD M. (M) chief chemist, General Petroleum Corp. of Calif., 2525 East 37th St., Los Angeles.

FLOOD, HENRY, JR. (A) executive vice-president, Devonshire Corp., 369 Lexington Ave., New York City.

FORSTNER, H. R. (A) parts and service manager, Campbell-Simpson Motor Co., 1109 Idaho St., Boise, Idaho; (mail) 1306 East State St.

GAGG, RUDOLPH FARWELL (M) assistant chief engineer, Wright Aeronautical Corp., Paterson, N. J.

GJERDE, M. D. (M) head, automotive div., technical dept., Standard Oil Co. (Ind.), 910 S. Michigan Ave., Chicago, Ill.

GLUHAREFF, MICHAEL E. (M) chief engineer, Sikorsky Aircraft, Div. of United Aircraft Corp., Bridgeport, Conn.

GREGORY, AUSTIN CHAS. (J) chief lubrication dept., Shell Oil Co. of Canada, Ltd., Toronto, Ontario, Canada.

HONDA, TOMIJIRO, MAJOR (M) inspector for aviation, Imperial Japanese Army Inspector's Office, 1775 Broadway, New York City.

IMFELD, CHARLES A. (FM) director, Societe Anonyme Adolphe Saurer, Arbon, Switzerland.

JENNINGS, HENRY (M) technical editor, Commercial Car Journal, Chilton Co., 56th & Chestnut Sts., Philadelphia, Pa.

JENNY, CLETUS JOHN (J) experimental engineer, Eclipse Aviation Corp., 545 North Arlington Ave., East Orange, N. J.; (mail) 90 North Arlington Ave.

KIMMEY, R. P. (A) field engineer, Joseph Weidenhoff, Inc., 4350 Roosevelt Road, Chicago, Ill.

KINCAID, FRANK M., JR. (J) engine designer, Waukesha Motor Co., Waukesha, Wis.; (mail) 427 West Park Ave.

KLINGER, JAMES D. (M) charge of material testing laboratories, engineering div., Chrysler Corp., Engrg. Dept., Detroit, Mich.

KUT, WALTER S. (J) Waukesha Motor Co., Exper. Dept., Waukesha, Wis.; (mail) 230 East Park Ave.

MEZEY, GEORGE (A) 34 West 83rd St., New York City.

NAGELY, JOHN L. (J) draftsman, Timken Roller Bearing Co., Diesel Engine Dept., Canton, Ohio; (mail) 1717 Market Ave., North.

SCANTLEBURY, WOODMAN FRANCIS (J) senior engineer, Nassau County Engrg. Dept., Mineola, L. I., N. Y.; (mail) 22 Second Ave., Port Washington, L. I., N. Y.

SCHULTZ, JOHN W. (M) automotive engineer, technical dept., Standard Oil Co. (Ind.), 910 South Michigan Ave., Chicago, Ill.; (mail) Stevens Hotel, Stevens Apts. 2011.

STAUFFER, GEORGE A. (A) sales manager, aluminum div., Thompson Products, Inc., Cleveland, Ohio; (mail) 2196 Clarkwood Road.

STEINER, EDWARD C. (M) mechanical engineer, Bridgeport Pattern & Model Works, Bridgeport, Conn.; (mail) 52 Remer St.

STIENSTRA, AUKE (J) junior engineer, American Bridge Co., Seventh Ave. and Second St., South East, Minneapolis, Minn.; (mail) 827 Upton Ave., North.

WEIDER, R. L. (J) laboratory engineer, White Motor Co., 842 East 79th St., Cleveland, Ohio.

Applications Received

The applications for membership received between Feb. 15, 1937, and Mar. 15, 1937, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

AFFLECK, GREGOR S., Detroit representative, Sterling Aluminum Products, Inc., Detroit, Mich.

ATCHESON, WINDSOR K., superintendent, The Pure Oil Co., Tulsa, Okla.

BABLER, WATT E., charge of automotive division, American Steel Foundries, Chicago, Ill.

BLAKEY, VICTOR GORDON, technical engineer, National Roads and Motorists' Association, New South Wales, Australia.

BOLEN, EDWARD P., trim sales engineer, National Automotive Fibres, Detroit, Mich.

BOLON, GUS GEORGE, shop foreman, Cascade Investment Co., Portland, Oregon.

BROWN, BENJAMIN EDMUND, JR., assistant instructor, United States Diesel Engineering School, Allston, Mass.

CASEY, FRANK E., assistant manager of sales, National Pneumatic Co., New York City.

CITROEN, LOUIS, manager's secretary, Societe des Petroles Jupiter, Paris, France.

CONWAY, WILLIAM E., assistant director truck sales, Studebaker Corp., South Bend, Ind.

CURNOW, HENRY LENNOX, technical engineer, Vacuum Oil Co., Johannesburg, S. Africa.

DECAUSSIN, EUGENE E., assistant engineer, Covered Wagon Co., Mt. Clemens, Mich.

DODDS, VINCENT G., salesman, Aluminum Co. of America, Los Angeles, Calif.

DUNHAM, THOMAS M., president, Aurora Equipment Co., Aurora, Ill.

FRAZEUR, LESLIE, supt. of maintenance, Eastern Air Lines, Miami, Florida.

FRINK, CARL H., 205-225 Webb St., Clayton, N. Y.

GODFREY, E. R., JR., pilot-engineer, Standard Oil Development Co., New York City.

GOLDEN, VERNON C., Diesel engineer supervisor, Atchison, Topeka & Santa Fe Ry. Co., Chicago, Ill.

HADLEY, WALTER C., automotive engineer, Socony-Vacuum Oil Co., Brooklyn, N. Y.

HOBELMANN, ALFRED HERMAN, sales engineer, Walter Kidde & Co., Inc., New York City.

HOLLINGSWORTH, R. BURNETT, branch manager, Autocar Sales & Service Co., Richmond, Va.

HULSE, STEWART H., fuels specialist, Standard Oil Development Co., Linden, N. J.

ISHERWOOD, HUGH JOHN, sales department, Ford Motor Co., Pittsburgh, Pa.

JACKSON, EDWARD W., JR., general service manager, Caterpillar Tractor Co., Peoria, Ill.

KERNS, PETER A., National account sales, Goodyear Tire & Rubber Co., Akron, Ohio.

LAWLER, JOHN ARTHUR, designing engineer, Evans Products Co., Detroit, Mich.

LEONBERGER, WILLLIAM HOWARD, shop superintendent, Gunther Brewing Co., Inc., Baltimore, Md.

MCGREGOR, THOMAS ATKINSON, chief engineer, American Forging & Socket Co., Pontiac, Mich.

MCWHORTER, JOHN FRANCIS, products development engineer, Ohio Rubber Co., Willoughby, Ohio.

MULLOOLEY, WILLIAM P., president, Auto Equipment Corp., Cleveland, Ohio.

NORTH, JOHN R., engineer, The Commonwealth & Southern Corp., Jackson, Mich.

NUKII, HARAKAZU, superintendent of service and maintenance, Kongo Motor Car Co., Tokyo, Japan.

ORSHANSKY, ELIAS, JR., vice president in charge of engineering, Acrotorque Co., New Haven, Conn.

PRAY, HARLEY L., owner, Tulsa Winch Mfg. Co., Tulsa, Okla.

RUBENFELD, ARNOLD, chemist, J. H. Rae Oil Co., Rochester, N. Y.

UHL, HARRISON J., sales engineer, Standard Oil Co. of N. J., New York City.

SAMPIETRO, ACHILLES CHARLES, technical assistant to the chief engineer, Thomson & Taylor Ltd., Surrey, England.

SAMUELS, WILLIAM, project engineer, Chevrolet Motor Co., Detroit, Mich.

SCANLAN, THOMAS A., owner, Scanlan Lock Co., New York City.

SCHLERETH, HOWARD J., manager, lubricating oil, Standard-Vacuum Oil Co., Iloilo, Philippine Islands.

SCHULTZ, HOWARD W., assistant chief engineer, Ohio Rubber Co., Willoughby, Ohio.

SCHUMACHER, RALPH O., motor vehicle supervisor, Postal Telegraph-Cable Co., New York City.

SCOTT, HARVEY A., general buildings, vehicles and supplies supervisor, The Bell Telephone Co. of Canada, Toronto, Ont., Canada.

SCOTT, LELAND L., designer and president, Scott Aircraft Motors, Kansas City, Mo.

SAE *Coming* EVENTS

Summer Meeting
May 4-9
The Greenbrier
White Sulphur Springs, W. Va.

T & M Public Utilities Meeting
April 15-16
Baltimore, Md.

Tractor Meeting
April 21-23
Pere Marquette Hotel
Peoria, Ill.

National Aircraft Production Meeting
Oct. 7-9
Los Angeles, Calif.

Baltimore—April 15-16
Hotel Belvedere. Participation in the Transportation and Maintenance Public Utilities Meeting of the Society.

Buffalo—April 13
Hotel Statler; dinner 6:30 P. M. Automotive Cooling Systems – L. P. Saunders, director of engineering, Harrison Radiator Corp.

Canadian—April 16
Regional Meeting, Prince Edward Hotel, Windsor, Ont., Canada; dinner 6:30 P. M. The Value of Salesmanship in Engineering – Frank B. Willis, vice-president in charge of sales, Bendix Products Corp.

Chicago—April 6
Hamilton Club; dinner 6:30 P. M. Hypoid Axles and Their Lubrication – C. E. Zwahl, lubrication engineer, Chevrolet Motor Co.

Cleveland—April 12
Cleveland Club; dinner 6:30 P. M. The TOCCO Hardening of Bearing Surfaces – W. W. Benninghoff, TOCCO division manager, Ohio Crankshaft Co.

Detroit—April 12
Statler Hotel; dinner 6:30 P. M. Textile Manufacture and Research – W. F. Bird, head of Research Division, Collins & Aikman Corp.

Indiana—April 15
The Athenaeum, Indianapolis; dinner 6:30 P. M. Subject – Blind Landing Systems Installed at Indianapolis Municipal Airport by Bureau of Air Commerce.

Kansas City—April 23
Hotel Kansas Citian; dinner 6:30 P.M. Diesel Fuels – T. B. Rendel, director, Motor Testing Laboratory, Shell Petroleum Corp.; Operation and Maintenance Problems of Diesel Streamlined Trains – E. F. Weber, superintendent of automotive equipment, Burlington Railroad.

Metropolitan—April 12
The Roger Smith, 40 E. 41st St., New York City; dinner 6:30 P. M. Diesel Engines in Motor Trucks – B. B. Bachman, vice-president, chief engineer, Autocar Co.

Milwaukee—April 2
The Milwaukee Athletic Club; dinner 6:30 P. M. Automotive Transmissions – Austin M. Wolf, automotive consultant.

New England—April 13
Walker Memorial, M. I. T., Cambridge, Mass.; dinner 6:30 P. M. Vibration – Prof. J. P. Den Hartog, Harvard Engineering School.

Northern California—April 13
Athens Athletic Club, Oakland, Cal.; dinner 6:30 P. M. Air Cleaners – Prof. F. A. Brooks, Division of Agriculture Engineering, Davis Laboratory, University of California; Oil Filters – Charles A. Winslow, consulting engineer.

Philadelphia—April 7
Engineers Club; dinner 6:30 P. M. Preventive Maintenance in Fleet Operation, with W. J. Cumming, general superintendent, Surface Transportation Corp., talking on engines.

St. Louis—April 3
Jefferson Hotel; dinner 6:30 P. M.

Washington—April 16
Cosmos Club, Washington, D. C.; dinner 6:30 P. M. Research – Thomas Midgley, Jr., vice-president, Ethyl Gasoline Corp.

(*Continued from preceding page*)

SELL, ANTONY, body engineer, Fisher Engineering Department, Detroit, Mich.
SHAY, EDGAR, experimental engineer, Chrysler Corp., Highland Park, Mich.
SMIRNOF, M. O., head designer, Moscow Automobile Plant, "ZIS," New York City.
SMITH, EDWIN, metallurgist, Electro Metallurgical Co., Detroit, Mich.
SMITH, FRANK WESLEY, manager, lub. oil sales, Cities Service Oil Co. of Pa., Boston, Mass.
STEWART, JOHN W., garage superintendent, The Ohio Fuel Gas Co., Columbus, Ohio.
STORCH, HAROLD A., engineer, Fisher Body Corp., Detroit, Mich.
TALAY, JOHN J., layout, Central Diesel Engineering, General Motors Research, Detroit, Mich.
WHITNEY, ERNEST G., engine research, National Advisory Committee for Aeronautics, Langley Field, Va.
WOOLSON, L. IRVING, chief engineer, DeSoto Motor Corp., Detroit, Mich.

Obituaries

Claude S. Briggs

Claude S. Briggs, an active figure in the early history of American automobiles and a member of the SAE since 1911, died in Detroit on March 1, following a long illness. He was 64 years old. Mr. Briggs became interested in the automobile business in 1909 when he founded the Krit Motor Car Co., of which he was president and general manager for one year. He then sold his interest and became general manager of the Brush Runabout Co.

Changing to the United States Motor Co., he developed their first four-cylinder car. In 1911 he formed the Briggs-Detroiter Co., and remained president and general manager until the business was discontinued in 1916. Mr. Briggs then affiliated with the Wilson Body Co., as sales manager and was especially active in the handling of war orders for that company during the World War. Selling his interest in the Wilson company in 1924 he associated with Benjamin F. Godfredson in the American Auto Trimming Co., and the Godfredson Truck Co. Since 1926 he had been engaged in the management of real estate and private investments.

Captain Matt Payne

Captain Matt Payne, a foreign member of the SAE since 1929, died Feb. 6, following a relapse after an operation. Captain Payne was known as an engineer of wide experience and ability. He is credited for much of the original development on heat, refrigeration and motor car design in England.

His connection with the automotive industry started in 1912, when he joined Messrs. Clement Talbot, Ltd., manufacturers of Talbot cars. After two years' experience in that company's shops and drawing department he affiliated with W. T. Clark & Co., Ltd., as chief engineer in 1914. Later that year he became technical officer in the British Army, serving through the World War and until 1920. Since then he has been chief engineer, Messrs. Holdell, Wray & Colt; technical advisor to the board of Clayton Wagons, Ltd.; consulting engineer, Clayton Dewandre, Ltd.; chairman, British Thermostat Co., Ltd. He established his own practice as consultant in 1931.

Captain Payne was born in 1890 and attended the Paddington Technical Institute.

Austin W. Deyo

Austin W. Deyo, who is known as the designer of the Larabee truck and was associated with the Larabee-Deyo Motor Truck Co., from 1915 until 1927, died on Dec. 5 following a heart attack. At the time of his death he was superintendent of construction and maintenance, New York division, Colonial Beacon Oil Co., Inc., with whom he had been affiliated since 1930 when that company purchased the Deyo Oil Co., of Binghamton, N. Y., of which Mr. Deyo was general manager. Mr. Deyo entered the oil business in 1927 after leaving the motor truck field.

Graduating from Cornell University with an M.E. degree in 1913, Mr. Deyo worked for two years as assistant engineer of tests and foundry representative for the Ingersoll Rand Co.

He was born in 1891 at Binghamton and joined the SAE in 1916.

Claude L. Coggins

The Society has recently been informed of the death of Claude L. Coggins of the Claude L. Coggins Co., San Pedro, Calif., car dealers. Mr. Coggins joined the SAE in 1915 shortly after receiving his B.S. degree from the University of Kansas. While a student he sold Chalmers cars during vacations. After graduating he continued selling cars, establishing a dealership in Wamego, Kan. He later moved to the Pacific Coast, organizing his company in San Pedro. He was born in 1890.

News of the Society

(Continued from page 24)

Tells of Maintaining 1000 Scattered Trucks

• Philadelphia

The Philadelphia Section is again able to report the largest turnout of the season. The record crowd attended the March 9 meeting to greet Harry T. Woolson, president of the SAE, and John A. C. Warner, its secretary and general manager. G. W. Laurie read his paper "Preventive Maintenance on the Chassis," and Norman G. Shidle, executive editor, SAE JOURNAL, spoke briefly.

Mr. Laurie, who is general manager, automotive department, Atlantic Refining Co., described the operation of a fleet of over 1000 scattered trucks and the changes that have been possible in the last few years as a result of improved vehicle design. In his fleet, he said, drivers do lubrication and simple tightening jobs in localities where there are not enough trucks to justify a mechanic in attendance. It is common, he stated, to start a truck out in service and to never see it in the shop again, routine maintenance being performed in the field by a traveling mechanic aided by the driver. Mr. Laurie also explained the office routine and described the forms used to keep headquarters informed of the work done in the field.

Reviews Important Ball-Bearing Facts

• Pittsburgh

Ball-bearings were discussed from every angle at the Pittsburgh Section's March 16 meeting. Introduced by Section Chairman Stephen Johnson, Jr., T. C. Delaval-Crow, New Departure's chief engineer, spoke on "Ball-Bearings and Ball-Bearing Applications."

He began by explaining the fundamentals of ball-bearing design, stressing how important it is that a ball has no axis of rotation. This, he said, allows the ball to roll freely to the position where it can best carry the load. The permissible load with flat raceways is only one-quarter that of grooved raceways, he stated, noting that the contact between the ball and a grooved raceway is not a point, but an ellipse of appreciable magnitude with its major axis across the direction of rotation. He also stated that about one-third of the balls are in use when carrying a radial load but that all balls carry a thrust load, explaining that shoulder height determines the difference between a radial and a thrust bearing.

The separator, Mr. Crow continued, is a plain bearing preventing inter-ball friction and acting as a conveyor to carry the balls around. Ball-bearings, he said, do not fail from wear, but only from fatigue or extraneous influences. Load-carrying ability, he added, varies inversely as the cube of the speed; bearing life varies inversely as the cube of the load.

Mr. Crow explained that when the inner race is too tight a fit on the shaft it may be expanded, but it will still be round. However, an outer race fitted too tightly into the housing will cause wrinkles or high spots on the raceway tending to cause rapid failure. Color of balls is no indication of failure, he added, as they may get bright the following week.

The speaker went on to say that contact pressures may be 130,000 lb. per sq. in., which indicates a metal-to-metal contact such as few lubricants could withstand. The reason that small particles of grit can cause so much trouble, he explained, is that by concentrating the load they may build up far higher pressures. He also noted that carbon from oil can cause trouble and that for this reason it is important to regularly drain and flush transmissions and to keep the lubricant at its proper level.

In discussion Mr. Crow answered a question from Ralph Baggaley, McCrady-Rodgers Co., about regrinding bearings by showing microphotographs which proved that fatigue failures begin in the metal below the surface of the raceway and that it is impractical to remove sufficient metal to insure continued reliability.

Discussion also brought out that it is better not to fill the bearing space more than one-third of its capacity with a lubricant, because the balls act as an efficient mixer, beating air into the lubricant and increasing its volume. It was also pointed out that oils must not oxidize too rapidly nor have too much fluid friction, and that sodium-soap greases are generally preferred.

Mr. Johnson concluded the discussion by explaining the method of using thumb pressure for fitting ball-bearings into aluminum housings which have been preheated in boiling water, and mentioning the economies in space secured by their use.

Other discussers included F. W. Heisley, Joseph Woodwell Co.; Harry Robb, Timken Roller Bearing Co.; and Richard Welker, Gulf Oil Corp.

Prior to the technical session F. W. Heisley was presented with an SAE watch charm in appreciation of services to the Section as its chairman during the past year.

Strides Seen in Mass Production Development

• Pittsburgh

Mass production and modernization of factory equipment was the subject treated by Joseph Geschelin in his talk before the Feb. 23 meeting of the Pittsburgh Section. Mr. Geschelin, who is technical editor, Chilton publications, was welcomed by 84 members and guests. He told them that with modern plant layout, it is possible to see raw materials enter a factory at the receiving bay and follow the flow of materials through converging lines until they emerge as completed cars and trucks at the shipping dock.

He explained that fundamental changes often come subtly as they are first tried experimentally, then, proving their value, sweep through the industry.

Production men, Mr. Geschelin said, have developed ways to utilize many of the methods of mass production in building certain parts in small numbers. He divided mass production into: mass production as such; job-mass production, using interchangeable unit assemblies; and job-lot production, where a batch of parts are produced and then the machine tool changed to produce a batch of different parts. He took Cadillac as an example of a plant using all three methods.

Interchangeability of units through an entire line of cars is a new conception, Mr. Geschelin said, noting that it shows a new kind of cooper-

Selected as Best

Morning Fog **is the title of this photograph taken by Seiichi Akabane, technical representative in the United States for Nakajima Aircraft Co., Tokyo, and a member of the SAE since 1931. It was awarded first prize in a recent wood, field and stream photograph contest sponsored by New York Times Wide World Photos, Inc.**

ation between the engineer and the production man. If this cooperation results in intelligent compromise, he added, neither engineer nor production man will have to give up all of his gains at the start of a new season's program, and a better automobile will be produced within the available limits of cost and machine-tool equipment.

Regarding surface broaching, he said that as it is now applied it is a fundamentally new manufacturing process and has made the large milling machines practically obsolete. He explained that single-point boring is a development of diamond-point boring which it has made practically obsolete, and that gear shaving has eliminated gear grinding almost entirely in passenger-car transmission production.

Mr. Geschelin also pointed out that streamlining has called for deeper and deeper draws, only made possible by great improvements in material and methods of processing. Fenders, such as used by Buick, he explained, call for local elongation of over 25 per cent in the sheet metal, adding that the availability of sheet metal possessing such properties is a great tribute to the steel industry.

In the discussion presided over by Chairman Stephen Johnson, Jr., O. W. Buenting, vice-president in charge of production, Westinghouse Air Brake Co., spoke of the debt owed to the automotive industry by other industries. Richard Welker, Gulf Oil Corp.; Murray Fahnestock, *Ford Dealer & Service Field;* Ralph Baggaley, Jr., McCrady-Rodgers Co., and John M. Orr, Equitable Auto Co., were among other discussers.

Drop in Mail Revenue Said Spur to Airlines

• Oregon

When air mail revenue dropped from $3.00 per lb. to 30 cents per lb. the airlines were forced into the passenger-carrying business, declared I. O. Cooper, chief mechanic, United Air Lines, when speaking before the March 12 meeting of the Oregon Section at the Imperial Hotel, Portland. Vast improvement in plane construction was the result, he added.

Illustrating the progress made Mr. Cooper said that 10 years ago motors had to be reconditioned after 100 hr. of service, and that now, due largely to improvements in metals, motors run 600 hr., between overhauls.

Since airliners cruise at 70 per cent maximum speed, he explained, 600 hr. of service would approximate 35,000 miles on an automobile engine running at 60 m.p.h. The wear these motors show at this point is amazingly small, he said, as the mirror-finished cylinder walls show less than one-half of one-thousandths of an inch wear. He added that the rest of the motor stands up equally well.

Mr. Cooper described how the supercharger and automatic carburetor keep the motor developing a constant rate of horsepower as altitudes vary. One reason for this being so important, he pointed out, is that any change in the hum of the motor frightens passengers.

Declaring that there is no such thing now as "blind" flying, he said the pilot is usually better off if he uses his instruments rather than his own judgment. Motors and instruments have been made so dependable, it was maintained, that most accidents now can be attributed only to pilot failure.

Among future developments in aviation Mr. Cooper said we can look for bigger planes, perhaps of 32 passenger capacity. He also foresees cabins "supercharged" so that planes can fly at 20,000 feet without passenger discomfort.

Three "Question Box" answers were submitted. Replying to "What causes ignition of crankcase fumes?" Ken Ayers was of the opinion that it is burning carbon falling from the bottom of cylinders. Otto Struss substantiated this opinion. Earl Marks discussed regulation of automatic chokes and Ray Kessler spoke briefly on cylinder plating.

One of the highlights of the meeting was Verne Savage's long-promised paper on "Canine Influence on the Modern Motor Car."

It was announced by Section Chairman M. E. Vande Water that United Air Lines had extended an invitation to all Oregon Section members to participate in an observation flight over Bonneville Dam, Grand Coulee Dam and Mt. Hood in the first of the new 21-passenger Douglas transport planes soon to arrive in Portland.

Of SAE 30915

This life-size bust of Katherine Cornell, leading American actress, is said to be the first piece of statuary to be cast in stainless chromium-nickel steel (SAE 30915). The mold was made from a plaster model by the sculptor, Karl Illava. It was cast by the Cooper Alloy Foundry Co.

It is one of many unusual applications of SAE Standards in fields far apart from the automotive industry.

SAE alloys are also finding use, for example, in a machine which will inscribe the Lord's Prayer on a *point* of a pin (diameter 0.005 in.), in ship-hull rivets, in roller-gate castings for dams, on the San Francisco-Oakland bridge, in oilwell drilling tools and accessories, and on the "marsh buggy" used to transport geophysical crews on land, open water and through the seldom penetrated marshes of Louisiana. This latter contraption was conceived by *A. A. Lane,* mechanical engineer, Gulf Research and Development Co., an SAE member.

N.A.D.A. Asks SAE for Serial Number Standard

A resolution asking the Society to establish a standard location for engine and car serial numbers has been received by the Engineering Relations Committee from the Board of Directors of the National Automobile Dealers Association. A certified copy is now in the hands of the Standards Department.

Such a standard, it is maintained, would make possible quick curbside identification of cars by police and overcome certain difficulties experienced by American travelers using their cars in European countries. Because the standard would be of little value unless followed by practically all manufacturers the Gasoline Engine division of the Standards Committee is questionnairing individual car makers to get the reaction of the industry.

Greater Use of Die Castings Predicted

• Detroit

"Just as the 'proper study of mankind is man,' so the study of die castings affords the best insight into their reason for being," and on this basis C. R. Maxon, of the New Jersey Zinc Co., discussed die castings for members of the Detroit Section on March 1 at the Hotel Statler. Examples representing current practice in the automobile industry were used to illustrate his paper.

Likelihood of greater use of die castings as structural elements, along with increased tendency to use decorative die castings, was stressed in the paper and accompanying slides. Steering wheel hubs for the wire spoke type wheels are die castings in many of the cars in the field. Steering column brackets, distributor brackets, shifter-lever trunnion and balls, headlamp and tail-lamp brackets, window frames and regulator units, many hardware and lock parts, door dovetail assemblies and a novel application of die casting in universal-joint manufacture, were other utility units which Mr. Maxon discussed.

Grilles and louvre applications received concentrated attention. The author declared that the decrease in the number of cars using die cast grilles in 1937 is attributable to delays in deliveries from jobbing die shops a year ago when production facilities were overtaxed, mostly because the number of die casting machines then available for making one-piece grilles was limited. While this condition has been improved, Mr. Maxon urged consideration of built-up grilles from smaller die castings. They can be produced more readily and generally, he said, with a saving of weight and an advantage in service replacement of parts.

There still is plenty of opportunity for the designer to use his ingenuity to advantage. Bi-metal applications, or the use of inserts of steel or other material in die castings, were suggested. The Bendix-Weiss universal joint, designed without the conventional trunnion, carries a steel ball between races supported by the yokes of the driving and driven portions. To unite the hardened races with the machined forged yoke at moderate cost and with precision, the yoke and two races are held in the correct positions in a casting die and the space between and around them is filled with zinc alloy. The zinc alloy is in compression during times of stress and has adequate strength for the design.

Closer dimensional limits can be maintained in die casting than in stampings, forgings or other castings, Mr. Maxon pointed out, and cast surfaces require little or no polishing or even buffing prior to plating. Remarkably thin stiff sections, as well as ornamental value, were claimed as attributes of die cast parts. The author expressed his opinion that the die cast grille "is invariably better in appearance as well as better in other respects than commercially feasible stamped types, though it is not always

the cheapest, and perhaps never the lightest construction."

To improve quality and cut costs, he suggested much earlier release of die-cast parts for new models and giving some of the "breaks" to the die caster rather than forcing him always to fit his product to the sheet metal. For both weight savings and appearance, he suggested the use of small die castings with stampings as has been done in some automobile grilles and on hood louvres.

In the discussion that followed C. E. Heussner, of the Chrysler Corp., pointed out that more die castings are ruined in the finishing room than anywhere else. Thoughtless operators will use a file or saw or other tool that cuts through the dense outer skin to the more porous interior. This procedure ruins the casting from the point of view of surface finish as well as structural strength.

Lightness is something to be sought in die castings, but should not be sacrificed to optimum operating costs, according to T. C. Fadgen of the Ternstedt Manufacturing Division of General Motors. A happy medium can be struck by proper cooperation between designers and die casters. Unusual shock resistance is the main consideration in all automotive applications, said Mr. Fadgen. The adoption of copper-free and low-copper alloys have made possible castings that are stable over long periods of time. As regards shock resistance, Mr. Fadgen gave credit to the New Jersey Zinc Co., for having done more to overcome the public resistance to die castings by licking this problem.

Competition between the custom die casters forces a "stretch" between the possible and impossible as far as practical shop considerations are concerned, said W. A. Maher, of the Precision Castings Co. The designers usually want to add what might appear as impossible conditions for economical castings, but this pressure has done more to force progress than anything else. The die cast grilles came about in this way, and Mr. Maher confessed that the grilles on the initial run were terrible. By the end of the season, however, rejections had been reduced from 17.5 per cent to 1.25 per cent.

Marc Stern of the AC Spark Plug Division of General Motors, traced the development of machines from the early days of hand pumpers, the adoption of air cylinders in 1914, pneumatic closing of dies, and finally the adoption of hydraulic means for forcing metal into the dies about five years ago. More recently, hydraulic cylinders are used to close the dies without the use of toggles, expensive to maintain. Mr. Stern also stressed the necessity of giving the die caster as much time to work out his dies as is given the fender die, instead of demanding eleventh hour service. He predicted a trend toward the built-up grille, which can be cast in generally available equipment. Few shops want to install the expensive machines for casting one-piece grilles, which seem to be passing out of the picture.

The possibility of a single-purpose alloy is exceedingly remote, it was stated by E. A. Anderson, in charge of research, alloys division, New Jersey Zinc Co., in answering a question from the floor. There are three recognized alloys today, SAE No. 921, SAE No. 925 and SAE No. 903, all alike except for the copper content, which runs 3, 1 and 0 per cent, respectively. The higher the copper content, the higher the tensile strength, and the lower the copper, the more permanence and stability. The SAE No. 921 alloy gradually loses its ductility and toughness, whereas the SAE No. 901 alloy retains its toughness under all working conditions.

The Detroit Section's March 15 meeting was postponed until March 30 because of a strike at the Hotel Statler. Thomas Henkel, E. G. Budd Manufacturing Co., was to speak on "Stainless Steel Construction of High-Speed Trains, Airplanes and Trailers," and George McCarroll, Sleeper Coaches, Inc., on "Sleeper Buses and Their Functional Design."

Diesel Operators Told Improper Fuel Costly

● Indiana

"The myth that Diesel engines will burn anything should never have been started. They just won't do that." So stated O. D. Treiber, chief engineer, Diesel division, Hercules Motors Corp., at the March 11 meeting of the Indiana Section. In continuing he said that if Diesels are ill-treated by use of improper fuel or lubricating oil, or neglected in the matter of cleaning the oil screens, they can cost the operator more in a short time than he could gain in a year of proper use and care. He added that the fuel injection pump can be made to outlast the engine if fuel entering the pump is clean.

In discussion, Mr. Trieber told Diesel operators to be wary of the oil man who says that he can "give you something just as good or better for your Diesel." Such a statement should be proved, he added. Mr. Trieber went on to say

that practically all oil men know the varying specifications of Diesel engines and the ones for which their particular oil is best suited. If the responsibility is placed on the oil man he will generally make a sound recommendation, he continued.

Lon R. Smith, Hercules Motors Corp., and founder of the Indiana Section, was a visitor from California. When called upon for remarks by Section Chairman C. C. Merz he said that Diesels have done wonders on the West coast and will do so elsewhere, but that "we must all quit over selling." This one thing, he continued, has done more damage than we can estimate and if allowed to continue might slow the tremendous upsweep in Diesel sales.

H. L. Knudsen, chief engineer of the Cummins Engine Co., Lee Oldfield, chief engineer, Bennett Manufacturing Co., and others also took part in the discussion.

SAE Representatives to Attend World Congress

When the 1937 World Petroleum Congress meets in Paris in June, the SAE will be represented by Vice-President C. Herbert Baxley, who heads the Society's Fuels and Lubricants Activity and is on the headquarters' engineering staff of the Socony-Vacuum Oil Co., George Calingaert, director, chemical research, Ethyl Gasoline Corp., and Alex Taub, Vauxhall Motors, Ltd., London, England.

Research Manager C. B. Veal, SAE headquarters' staff, who has been designated official representative of the Cooperative Fuel Research Committee, of which he is secretary, will present a report at the World Congress. He will also represent the SAE.

History of Diesel Development Traced

• New England

More than 700 members and guests of the New England Section welcomed SAE President Harry T. Woolson and General Manager John A. C. Warner to its March 5 meeting. Other speakers were H. Austin Murray, The Texas Co., and H. E. Fenner, United American Bosch.

Tracing the development of the Diesel engine from 1892 when Dr. Diesel was awarded a patent on his plan to use crude oil for power, until 1936 when 1,850,000 hp. of Diesel engines were sold, Mr. Murray compared the early engines with those of today. In 1903, he said, Diesel engines weighed 200 lb. per hp. There were many complications, he added, when attempts were made to increase speeds, but that continued experiments have developed types which give greater horsepower with far less weight and that are more flexible.

Mr. Murray quoted figures showing that more Diesel engines go into tractors than are used for any other purpose. He added that stationary units, trucks, marine types, contractors' equipment and railroad engines follow, in that order.

Mr. Fenner devoted his talk to Diesel fuel-injection systems and illustrated their operation with numerous slides.

Means of Improving Lubricants Explained

• Metropolitan

Improvement in lubricants has kept pace with fuel development during the past few years, Dr. George Maverick, assistant manager, Standard Oil Development Co., stated in speaking on "Modern Trends in Motor Oils," before the Metropolitan Section, March 8. On the same program Neil MacCoull, research engineer, Texas Co., presented films showing how the flame of combustion behaves in the cylinders of both Diesel and gasoline engines, and spoke briefly on the subject. F. L. Miller, Section vice-chairman for fuels and lubricants, introduced the speakers following short talks by SAE President Harry T. Woolson and John A. C. Warner, secretary and general manager. Chairman T. C. Smith of the Section presided.

"Largely as the result of refining alone," Dr. Maverick continued, "oils now being made are of high initial performance characteristics and they retain these characteristics over a long period of use. Lately the use – and very successful use – of addition agents has increased enormously. Already oiliness agents, viscosity and viscosity-index improvers, pour inhibitors and oxidation and corrosion inhibitors have each been used by leading manufacturers in many hundreds of thousands of barrels of lubricating oils of the highest quality. It seems likely that further advances in engine design which place more rigid requirements on lubricants will be met by the increased use of addition agents."

Tracing the development of polymers from the laboratory and into industry, Dr. Maverick disclosed a train of intensive research in addi-

tives to increase the performance of petroleum-base automotive lubricants.

Cooperative research projects being run under the supervision of the SAE will, he predicted, settle the long-standing controversy whether or not oiliness agents which do not harm any metals in any engine do very much to reduce friction.

"Crankcase oils of the future should be made with the same precision and understanding that metallic alloys are made today," he said, and predicted that better lubricants will be made synthetically for the more rigorous demands of today's engines. In the meantime, the automotive industry must depend upon the refiners to supply their needs with the less expensive petroleum-base lubricants, carefully refined to assure complete cleanliness and freedom from useless impurities and protected by the addition of necessary modifiers.

Good oil, he said, must rate high in the following characteristics:

Its consumption must be very low.

It must start readily in winter, and flow instantly on the coldest start.

It must not form sludge, or stick rings, or leave too much carbon on vaporization.

It must stand greater loads and higher speeds.

It must not break down and form products which corrode metal bearings.

Cummins Speaker at Annual Diesel Meeting

• So. California

"The biggest problem in Diesel design is not how to get the fuel into the combustion chambers, but how to properly distribute this fuel to obtain maximum efficiency," C. L. Cummins, president, Cummins Engine Co., said in addressing the annual Diesel meeting of the Southern California Section, Feb. 19. More than 200 members and guests attended the pre-meeting dinner at the Town & Gown Foyer of the University of Southern California, and many more crowded the huge auditorium to capacity when Mr. Cummins spoke. Six past-chairmen of the Section were present and introduced by Chairman L. J. Grunder.

Mr. Cummins, who was introduced by Herbert Wirshing, chairman of the Section's Diesel engine committee, elaborated on the opening statement by explaining that fuel will not burn on a surface; it must be in the air where it can obtain a marriage with oxygen. Therefore, he said, it is a serious problem to inject the fuel in such a manner that it will not be deposited on a surface.

Continuing, Mr. Cummins said, "Proper combustion is the major problem in smoke and odor control. The chemical constituents of modern fuel oils are the chief offenders and we look for relief through the untiring efforts of the oil industry in developing better fuels.

"Gravity of fuel oils does not determine their suitability for Diesel operation," he added, declaring, "there is undoubtedly some other factor yet unknown. It might be lubricating qualities. Much research must be done to provide an answer to this problem."

In this connection, Mr. Cummins told of an interesting experience. "While testing various fuels submitted by oil companies for use in a Diesel car entered in the Indianapolis races," he said, "a mistake was made in shipping a barrel of oil never intended for Diesel use on the track. This oil of unknown composition was placed in the car and gave such outstanding performance that it was used in the race. It is possible that the success of this particular product resulted from its ability to seal points of leakage."

Stating that normally a Diesel consumes much less oil than a gasoline engine, Mr. Cummins explained that the oil temperature rarely rises above the water temperature. "Manifold vacuums," he said, "are low, therefore, reduced consumption may be attributed to very light drag on the oil through the rings. Sticking rings were first thought to be caused by lubricating oil but later it was found that they could be eliminated by redesigning pistons. Viscosity in lubricating oils is an important factor in obtaining maximum horsepower. A change of oil to new oil of the same viscosity as the original will result in appreciable drop in horsepower. Lighter oils are to be advocated."

The speaker explained that vibration dampers are not suitable for control of torsional reactions in a Diesel engine. This problem, he said, has been solved by enlarging the crankshaft so that natural periods of vibration are above the operating speeds of the engine. The crankshaft of the automotive Diesel engine under discussion weighs 225 lb. and the main bearing size is as large if not larger than the bore of the engine. The flywheel weighs only 36 lb. Rubber mountings of the type used in gasoline passenger cars are desirable for the reduction of torsional vibration, he added.

On the development of Diesel engines in Europe, Mr. Cummins said, "they are far behind development in the United States. They have entirely different operating conditions than we have, using Diesels only for short hauls at low speeds with light loads. The American

Diesel is foolproof in operation whereas the control board on a European Diesel is as complicated as the keyboard on a pipe organ."

In the discussion which followed opinions and experiences were related by Mr. Duntley, Pacific Freight Lines; W. E. Powelson, vice-chairman of the Section and master mechanic, Los Angeles County Fire Department; W. B. Collins, Luber-Finer, Inc.; E. E. Tattersfield, president, Electric & Carburetor Engineering Co.; John Wiggers, chief engineer, Moreland Motor Truck Co.; Calvin Austin, engineer, Los Angeles Bureau of Water & Power.

In introducing his subject Mr. Cummins presented a series of slides showing stages in the evolution of the present high-speed Diesel engine and various methods of fuel injection.

The Jan. 29 meeting of the Southern California Section was devoted to a review of the papers presented at the SAE annual meeting in Detroit. Section Chairman L. J. Grunder shared the program with Dr. Ulric B. Bray, assistant manager of research, Union Oil Co. of California, and Fred C. Patton, general manager, Los Angeles Motor Coach Co., and superintendent of transportation, Los Angeles Railway Corp., all of whom had attended the meeting.

Besides giving an account of the Detroit convention, Mr. Grunder reviewed his trip by automobile through the flood areas in the South.

23% of SAE Committee Personnel New in 1937

The vitality of SAE technical and administrative committees is due in no small part to the prompt and precise review of the activity of committee personnel which takes place with the change in SAE Presidential administration each year, according to President Harry T. Woolson, who has been making a special study of SAE committee changes and policies.

While continuity of action is preserved through maintenance of committee personnel which has been active and effective, new blood is constantly being injected as additional Society members evidence interest in and competency for particular committee activity—and members whose interests have changed or whose affairs no longer permit active participation are eliminated.

In 1937, for example, 23.6 per cent of the SAE committee personnel consists of new names —men who did not serve in 1936. About 285 new names were added to the various Society committees.

In the Research and Standards division committees, where much of the great technical work of the Society is carried forward, somewhat greater continuity of personnel seems to have been found desirable. But even in these divisions, widespread changes were made. In the Research committees, 14.5 per cent of the personnel is new; 42 new names were added.

In the Standards committees, new names this year constitute 14.3 per cent of the total membership of these divisions.

To make room for these fresh workers throughout the Society committee activities, 214 men were removed from particular committee responsibilities, while 46 others, serving in 1937 on the same committee as in 1936, have been given new responsibilities or positions in connection with their work.

While the size and personnel of all Society committees naturally have limits dictated by the need for flexibility and action, every committee chairman is deeply interested in hearing from every Society member who may be interested in a particular line of activity and to provide further current as well as general information about the progress of efforts in connection with his specialty.

Modern Electrical Equipment Described

• Baltimore

Although electrical loads have increased from about 7½ amp., on cars of ten years ago to 24 amp., on cars of today, these requirements have been met without increasing the size of the generator or greatly increasing its cost, but by improving its design, according to R. M. Critchfield, chief engineer, Delco-Remy Corp., in his paper on, "Modern Automotive Electrical Equipment" presented before 70 members and guests of the Baltimore Section, March 4.

These added requirements, he said, have resulted from increased headlamp, horn and ignition loads as well as from the increased use of heaters, radios, defrosters, and other electrical accessories. To illustrate, he gave figures showing that in the past seven years, sales of heaters have increased from 270,000 to 2,250,000 and of automobile radios from 34,000 to 1,625,000.

Storage battery improvement, he said, has centered principally on meeting the increased starting load resulting from more severe cold-engine cranking loads, and increasing tendency to use cars in extreme cold weather. One improvement has been the use of a greater number of thinner plates per cell and another better

performance of the negative plate. Performance of the present-day battery, he estimates, is approximately 15 per cent better in hot weather and 45 per cent better in cold weather, as compared to the battery of ten years ago.

Mr. Critchfield does not believe that there has been more than 10 per cent improvement in the starting motor itself during the past several years, but that better batteries and use of low-viscosity oils in winter months have improved its starting ability. Improvement in the means of engagement between the starting motor and the engine has also contributed to better starting, he added.

The speaker also noted that a Diesel engine takes a great deal more power to get started than a gasoline engine of the same cubic-inch displacement. This, he explained, is due in part to heavier construction and higher friction; in part to the higher compressions used, which impose heavier loads on the friction surfaces, but mainly to the fact that engines of this type require cranking at speeds of from 125 to 200 r.p.m. in starting, while the gasoline-type engine will start when cranked at from 30 to 40 r.p.m.

The gasoline-engine ignition system has remained fundamentally the same for the past 15 or 20 years, he said, adding that much has been accomplished in refinements of distributor design, largely due to increasing knowledge as to the requirements and the application of common physical laws. Condensers, he remarked, have been made more compact, less expensive and more reliable.

In concluding, Mr. Critchfield said that horns have probably been subjected to more changes in type and design in the past 10 or 15 years than any other unit of the automobile. This, he said, is probably not so much due to the fact that the original horns were so bad as to the very definite opinion that each car owner has, as to how he feels his horn should sound. He remarked further that despite the fact that the out-in-front mounting of horns is in general more effective, the under-the-hood mounting makes the horn sound louder to the people in the car on which it is installed, so most owners prefer their horn under the hood—believing it to be the better signal.

No. California Section Meeting

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can be made to appear stationary and its actual condition observed at various intervals.

By means of slides he demonstrated that fuel injection occurs in the form of several impulses or needle flutters, rather than a continuous and uniform flow.

A second machine described by Mr. Maxwell, known as the rate-of-discharge meter, permits the rate of fuel injection over the entire fuel injection period to be measured in very small increments. Both machines, he said, show that the design of the injection equipment and the engine itself must go hand-in-hand if peak performance is to be obtained.

With additional slides he demonstrated the unduly high pressures which develop within a Diesel cylinder when injection is too rapid due to too fast a cam or other causes. Similarly, the results of too slow injection were demonstrated. Emphasis was laid on the fact that cam profile is only one of the governing factors.

Following Mr. Maxwell's paper, discussion covered such things as nozzle-opening pressure and its effect on atomization, the use of engine tachometers to insure the engine being operated at efficient speeds, the inadvisability of eliminating all tendency of detonation by reducing the initial fuel injection to the point that poor atomization will result and the necessity of having fuel lines from pump to injection nozzle identical in properties for all cylinders. It was also brought out that Mr. Maxwell does not consider it essential to use a fuel higher in cetane value than is necessary to produce minimum knock and good starting.

C. G. A. Rosen, also of the Caterpillar company, stressed the importance of designing the Diesel engine to fit the purpose for which it is intended. Though inherently economical, they can fail, he said, if poor design results in excessive maintenance charges. With this in mind he stated that his company's engines are designed for 4000 hr. of operation between major overhauls. During this time, he continued, the operator can tell if the torque or horsepower output fall off, and it is thus essential that these evidences of the engine's life not be sacrificed by poor design or short-sighted savings in engine construction costs. To bring about this engine life, Mr. Rosen explained, a combustion system was designed which will not influence the nozzle characteristics throughout this period of time, thus preserving the power and torque of the engine. In concluding, Mr. Rosen expressed his opinion that the pre-combustion-chamber-type cylinder is responsible for much of the success of the engine in this regard.

Huge Attendance At Annual Dinner Dance

● No. California

The Fairmont Hotel, San Francisco, was the scene of the Northern California Section's annual dinner dance, Feb. 6. Under the chairmanship of A. H. LauFer it attracted approximately 350 members and guests, including groups from related automotive organizations in the area. Excellent entertainment and good music made it a most enjoyable affair.

Working with Chairman LauFer on the dinner-dance committee were Section Chairman A. G. Marshall, E. G. Reid, U. A. Patchett, W. S. Crowell, G. L. Neely, W. G. Thomson, A. B. Domonoske, Carl J. Vogt, J. R. MacGregor, Howard Baxter, C. W. Spring and E. E. Meybem.

Says Diesels Prove Value in Truck Field

● N. Y. U.

Noise, smoke, odor and vibration have ruled out the Diesel engine for passenger-car use, Lacey H. Morrison, editor of *Diesel Power,* told students and faculty members attending the first smoker of the new term held by the SAE Student Branch at New York University, Feb. 9. The high first cost of Diesel engines as compared to that of modern gasoline engines is another factor that hinders its widespread use for passenger cars, he added.

However, he said, Diesel engines are proving their value in the truck field, particularly for long-haul work. With increased taxes on trucks and fuels being levied, and the possibility of higher labor costs due to laws governing hours of drivers, the high-speed Diesel will play an important part in keeping costs at present levels, Mr. Morrison believes.

The farmers, he said, particularly benefit from the economies of Diesel engines because they can purchase tax-free fuel.

Railroads are not an important outlet for Diesel engines, Mr. Morrison stated, inasmuch as few locomotives are built in the course of a year and the majority of them are steam and electric units.

In answering questions from the floor the speaker discussed and illustrated such combustion chambers as those used in the Ricardo and Waukesha engines and the modified spherical chamber used by Hercules.

Periodic Inspection Theme of Safety Talk

● Northwest

"The successful future of highway transportation depends upon vehicle behavior on the highways. Consequently, we cannot afford to overlook the smallest details involving accident prevention."

This was the opening comment of H. W. Drake, superintendent of equipment, Pacific Highway Transport, in addressing the Northwest Section's February meeting on the subject "Mechanical Condition vs. Highway Safety."

Mr. Drake established the tangible and intangible benefits of municipal or state periodic vehicle inspection by indicating the shortcomings of what is now considered good fleet maintenance. He offered the following statements regarding equipment for making this maintenance more thorough from the safety angle:

> "The effectiveness of brakes cannot be determined without the use of some instrument or machine which will positively indicate equalization and braking power."

> "Headlights cannot be properly adjusted without the use of apparatus which will indicate both distribution and intensity of light."

> "It is impossible to determine by casual observation or by use of a broomstick the true condition of front wheel alignment. Wandering, shimmy and hard steering are often contributors to accidents. There is seldom introduced into the solution of an accident any such factor, yet there is often every reason to believe that many head-on collisions occurring on perfectly straight highways are the result of these imperfections."

In concluding, Mr. Drake cautioned commercial fleet operators to "clean their own houses" before finding fault with the other fellow because of his disregard for safety. "It is far better," he said, "to invite cooperation by setting an example than to request compliance by others without contributing. Utilization of periodic inspection will not only simplify our own maintenance problems, but will reduce the hazard created by other people's faulty vehicles."

A short outline of the ordinance creating Seattle's new Motor Vehicle Testing Station was given by H. E. McMorris, supervisor of the station. Discussion was led by E. C. Van Horn, director of the station.

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Spring Design and Material Discussed

● Canadian

Talking on helical-coiled springs from a design and material viewpoint, F. P. Zimmerli, chief engineer, Barnes-Gibson-Raymond Division of Associated Spring Corp., addressed 75 members and guests of the Canadian Section at its regular monthly dinner meeting, Toronto, Feb. 17. Section Chairman Max Evans presided.

Methods used to produce hard-drawn tempered valve spring and music wire were considered by the author in the light of when and why the different grades should be used. He suggested the use of the Wahl formula and outlined stresses that the wires would withstand.

Mr. Zimmerli explained the effects of corrosion and plating embrittlement, calling particular attention to the minute amount of corrosion necessary to cause breakage. The time element varies with the duty imposed, he added, as springs under a static load can be very considerably corroded without failure.

In concluding his talk, which was well illustrated with slides, Mr. Zimmerli outlined methods of spring testing and inspection, calling particular attention to the poor practice of some laboratories of over-stressing spring steel and trying to postulate spring life from these results.

Charles Edward has been appointed chairman of the Canadian Section's Annual Golf Tournament to be held early this summer.

Says "Sportsmanship" Best Safety Appeal

● Milwaukee

"Traffic Accidents and What We Can Do About Them" was the vital subject of a talk by Burton W. Marsh, director, safety and engineering department, American Automobile Association, before the Milwaukee Section, March 5.

Mr. Marsh, who was formerly traffic engineer of Pittsburgh, and later of Philadelphia, emphatically stated, "Motor-car fatalities can and must be reduced!" He told of the aggressive safety campaign being carried on nationally by the AAA and stressed the point that in driver education an appeal to sportsmanship has proven far more effective than campaigns imploring motorists to drive safely and carefully. This, he said, is particularly true in appealing to younger drivers.

Film Shows Building of "Miss America X"

● Chicago

A highly interesting and informative address on international championship speedboat racing by Gar Wood, Detroit's premier speedboat racer, presented through the medium of a talking motion picture, was a special feature of the Chicago Section's "Ladies' Night" held March 5 at the Medinah Club, Chicago. Gar Wood's film, shown before 125 members and their guests, thrilled the audience with its dramatic presentation of *Miss America X's* design, construction, testing and eventual achievement of the world's honors in speedboat racing – possession of the famous Harmsworth Trophy.

Gar Wood, virtually taking the film audience right into the shop, explained the special design of *Miss America X's* hull, a design which triumphantly withstood the terrific strain of the 6400 hp. powerplant comprised of four 1600 hp. Packard motors in tandem, the motors which drove *Miss America X* to a new world's record of 124.95 m.p.h. on the St. Clair River in Michigan, Sept. 20, 1932. In this race, *Miss America X,* with Gar Wood at the wheel, beat Kaye Don's record by 5.1 m.p.h. Mr. Don drove *Miss England III* 119.81 m.p.h. on Loch Lomond, Scotland, July 18 of the same year. For comparison, history of speedboat racing since 1921, is given as follows:

Date	*Driver*	*Record (miles per hour)*
Sept., 1921	Gar Wood	80.567
Sept., 1928	Gar Wood	92.862
June, 1930	Major Seagrave	98.76
March, 1931	Gar Wood	101.154
March, 1931	Gar Wood	102.256
April, 1931	Kaye Don	103.45
April, 1931	Gar Wood	103.069
July, 1931	Kaye Don	110.223
Jan., 1932	Gar Wood	110.785
Feb., 1932	Gar Wood	111.7196
July, 1932	Kaye Don	119.81
Sept., 1932	Gar Wood	124.915

An entertaining floor show and dancing concluded the evening's program which was under the direction of Len Gilbert, chairman of the Section's entertainment committee.

About Authors

(Continued from page 11)

• **William J. Davidson** *joined Cadillac soon after graduating from McGill University in 1913 with his B.S. degree. Except for a period during the World War when he was captain in the Motor Transport Corps, serving in France, he has been with General Motors. After the War he was awarded the Cross of the Legion of Honor by France, not only for his war service but also for friendly cooperation with French engineers since. In 1923 he was promoted to the staff of GM's president, Alfred P. Sloan, Jr., and was made executive secretary of the general technical committee which built and operated the corporation's vast proving ground. Besides his present work as director, technical section of General Motors, he is the first chairman of the SAE Engineering Relations Committee established last year.*

• **Fred L. Faulkner** *entered the army in 1918 as master signal electrician and was transportation officer when mustered out. His career since that time has been in the automotive field; managing truck fleets and teaching automotive subjects. He inaugurated the first night-school course in automobile mechanics in the Chicago high schools and has been active in educational work for ex-service men. Since 1926 he has been automotive engineer and manager of Armour & Co.'s automotive department. He was graduated from Armour Institute with a B.S. degree in 1915 and received his pre-War training as electrical engineer from Western Electric, and Campbell, Wyant & Cameron Co. Active in SAE work Mr. Faulkner is chairman of the Chicago Section and is chairman of the transportation division of the Society's General Standards Committee.*

• **J. B. Johnson,** *after leaving Cornell University with an M.E. degree in 1912, spent six years in the motive power and mechanical engineering departments of the Pennsylvania and the New York Central railroads. He then joined the War Department where he has remained since that time developing and testing aircraft materials and fabricating processes in the engineering and inspection departments. He is now chief of the Material Branch at Wright Field. Mr. Johnson has written several papers dealing with materials and is author of a book on aircraft welding.*

• **Wheeler G. Lovell** *has done a great deal of research on the utilization of gasolines in automobile engines with the idea of securing a better fitting together of fuel and engine. This involves correlating the chemistry of fuels and the physics of their combustion with the mechanical engine. He is a graduate of M.I.T. and has been affiliated with the General Motors Research Laboratories Section since shortly after his graduation. He is now assistant head of the fuel department.*

• **C. G. A. Rosen** *served in machine shop, forge, foundry and drafting room on oil-engine construction and repair after graduating from Cogswell Polytechnic College and the University of California with B.S. and M.E. degrees. He was Diesel engineer and chief engineer with Dow Pump & Diesel Engine Co., from 1915 until 1922 when he engaged in the practice of consulting and research engineering. During his seven years as consultant he also was instructor in Diesel Engines for the U. C. Extension Course, contributed to several motor-boat publications and was author of one and co-author of another Diesel-engine correspondence course. He joined Caterpillar Tractor Co. in 1929.*

Notes and Reviews

THESE items, which are prepared by the Research Department, give brief descriptions of technical books and articles on automotive subjects. As a rule no attempt is made to give an exhaustive review, the purpose being to indicate what of special interest to the automotive industry has been published.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

AIRCRAFT

Aircraft Engines – Theory, Analysis, Design and Operation

By Arthur B. Domonoske and Volney C. Finch. Published by John Wiley & Sons, New York, 1936; 342 pp., illustrated. [A-1]

The aim of the authors in preparing this volume has been to design a textbook in engineering courses for undergraduate and post graduate students and to offer a collection of material largely new dealing with the design, construction, operation and maintenance of aircraft engines.

This book covers the basis theory and principles of aircraft engine design and operation. Chapters of particular interest bear the following titles: petroleum fuels and their explosive reaction; detonation and anti-detonants; combustion processes in aircraft engines; supercharging; waste heat and cooling; and testing of aircraft engines.

Materials are discussed only when involved in principles.

La XV[e] Exposition Internationale de l'Aéronautique

By R.-J. de Marolles. Published in *Le Génie Civil*, Nov. 28, p. 469, Dec. 5, p. 505, Dec. 12, 1936, p. 528. [A-1]

A feature of especial interest in the 15th International Aviation Show recently held at Paris was the section devoted to aeronautic education of young students, a project which is now engaging the earnest attention of the French government. Among the civilian planes, the very small, so-called "popular" type occupied a place of major importance, at the expense of touring or commercial transport craft designed for the serious business of aviation. This is attributed to the abrupt discontinuance of government rebates on the purchase price of the latter type of airplane. Military airplanes were no longer grouped as pursuit, observation and bombing, but as light, heavy, and special purpose.

Among design trends the following were noted: an almost complete triumph for the monoplane; great difference of opinion as to materials of construction, of the exhibits, only 20 per cent being all-metal; an increase in the use of special steels at the expense of aluminum; greater comfort; steadily increasing favor of air cooling; slight preponderance of the radial engine; failure of the Diesel to enter the field of practical usage, in spite of government encouragement; and increasing importance of the small engine.

Brief descriptions are given of the exhibits.

L'Aviation en 1937

Published in *La Technique Moderne*, Nov. 15, 1936, p. 769. [A-1]

This issue deals with 6 aspects of aviation in as many different articles. The director of the Lille institute for the study of the mechanism of fluids describes apparatus used in teaching aerodynamics to young students. The function of radio in aviation and the equipment through which it operates are summarized. Airport planning and equipment are briefly dealt with. C. Martinot-Lagarde, general inspector for aviation, traces engine design trends that have led to the growing improvement in performance, and describes outstanding French products. The use of aluminum and magnesium alloys, and the problems of engine lubrication are the subjects of short articles.

Zusammenfassender Bericht über den Instationären Auftrieb von Flügeln

By H. G. Küssner. Published in *Luftfahrt-Forschung*, Dec. 20, 1936, p. 410. [A-1]

A summary is made of theories developed relating to fluctuating wing lift. The results concerning air forces on a wing in unsteady movement have been hitherto obtained for the case of plane flow according to the eddy method. This note covers, as familiar examples, the vibrating flat plate with rudder and the case of sudden changes of direction, and, as new results, the eddy current loss of a vibrating plate and change of circulation on flying into air jet fields.

The conclusion drawn is that the theory of fluctuating lift in plane

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SPEAKING OF RANGE OF ACTION!
Nature solved the giraffe's food problem by providing long "range of action." Similarly, science has solved the problem of keeping bolted assemblies tight . . . the *helical* Spring Washer. In either case . . . adequate range of action is essential. To keep machinery *tight*, a bolted assembly *must* include a *helical* Spring Washer of adequate *range* and *power*.
SPRING WASHER INDUSTRY
616 WRIGLEY BUILDING, CHICAGO, ILL.
ONLY A HELICAL SPRING WASHER HAS ADEQUATE RANGE OF *Live Action!*

NOTES AND REVIEWS

Continued

flow has been so developed as to make possible the solution of even difficult problems, such as wings vibrating at varying amplitudes. Experimental confirmation of the theory needs further work. In further development of the theory, it is expected that the difference in results between two and three-dimensional handling of practical questions will be less than for cases of uniform lift.

VIII^e Tableau de l'Aéronautique Française – 15^e Salon de Paris

By Pierre Léglise. Published in *L'Aéronautique,* November, 1936, p. 219. [A-1]

The object of the descriptions of French aircraft here given is not to cover completely all models being manufactured; but to concentrate on and discuss fully all new developments during 1936. To 37 makes are devoted almost 100 pages of description, photographs and original sketches.

Untersuchung der Bewegung einer Platte beim Eintritt in eine Strahlgrenze

By H. G. Küssner. Published in *Luftfahrt-Forschung,* Dec. 20, 1936, p. 425. [A-1]

The experimental investigation here reported was carried out to test assumptions made in theoretical treatments of the vertical penetration of a plate into an air jet field. The problem is of practical application in the investigation of stresses on wings due to gusts.

A rectangular plate of symmetrical profile was permitted to fall through the free stream of a wind tunnel and photographed. The experiment indicated that during the penetration of the free stream by the plate no moment of measurable magnitude was exerted about the neutral point.

Essais de Maniabilité et Instruments

By Fr. Haus. Published in *L'Aéronautique,* October, 1936, *L'Aérotechnique* section, p. 129. [A-1]

Qualitative measurements or opinions of pilots are no longer considered to be satisfactory results of flight tests of maneuverability; exact, complete measurements of the reactions of the aircraft in all flight conditions are required. The apparatus here described for the obtaining and recording of such measurements consists of an instrument panel on which the indicating dials are compactly assembled, and a motion picture camera suitably mounted for photographing the panel during flight tests. The apparatus was developed in the Rhode-Saint-Genèse aeronautical laboratory in Belgium. Typical curves, obtained by it through the determination of 8 points a second, are reproduced.

Das Ebene Problem der Flügelschwingung

By R. Kassner and H. Fingado. Published in *Luftfahrt-Forschung,* Nov. 20, 1936, p. 374. [A-1]

A simple, graphical method for rapid determination of the critical speed of a given wing is described. In the development of this method the wing is considered to be without ailerons and internal damping. From examples worked out according to the method, guiding rules are deduced for the design of wings satisfactory from the viewpoint of vibration characteristics. In a second article wings with internal damping are similarly considered.

Saint-Pierre et Miquelon et les Antilles

By Jean Pouyer. Published in *Revue du Ministère de l'Air,* October, 1936, p. 1260. [A-4]

The importance as possible bases of trans-Atlantic air lines of the French islands of St. Pierre and Miquelon in the north, off the coast of Canada, and of the Antilles in the south, off South America, is here discussed.

La Réorganisation de l'Armée de l'Air

Published in *Revue du Ministère de l'Air,* October, 1936, p. 1231. [A-4]

Having obtained aircraft of satisfactory design and in sufficient numbers, the French Air Ministry undertook the second task necessary to provide an efficient air force, the organization of its personnel. All functions relative to aerial defense were grouped under a single high command; the powers and relations to one another of the chief officers were newly defined; peace-time stations of various units were reassigned; the supply of general petty officers was augmented and methods of recruiting and training such officers were revised.

Zur Entstehung des Luftschraubengeräusches

By W. Ernsthausen. Published in *Luftfahrt-Forschung,* Dec. 20, 1936, p. 433. [A-4]

Studies were made on a propeller model of the origin of propeller noise. Investigation was made of the relation between the field of pressure and the field of sound, of the composition and direction of the

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sound emitted, and the effect of obstacles in the neighborhood of the propeller and of peripheral speed.

Some of the findings of the investigation are: the measured field of pressure of the propeller coincides with that theoretically determined; the field of sound is made up of steady "rays" or emissions in the direct neighborhood of the blades; the magnitude and spectrum of the sound is affected by blade form and angle of attack; high components enter to a considerable extent into the spectrum; obstacles can increase the noise and change its direction; to be quiet a propeller must have a peripheral speed of less than 820 ft. per sec.

CHASSIS PARTS

Rollt das Rad über die Fahrbahn?

By E. A. Wedemeyer. Published in *Automobiltechnische Zeitschrift*, Jan. 10, 1937, p. 15. [C-1]

The extent to which the wheels of a car are in contact with the ground, under current conditions of light weight and high speed, is the concern of the author. He refers descriptively to various research instruments, such as seismographs, accelerometers, trailers equipped with measuring apparatus and headlight devices, and recommends them only for the measurement of road roughness or the integrated effect of such roughness on the general movement of the vehicles.

For definite determination of the movement of any one part of the vehicle with reference to another or to the road, he suggests and describes a photographic apparatus, and reports findings made with it. He concludes that the vertical movement of the axle relative to the road is great enough to merit consideration because of its effect on security in running and braking. To reduce that movement he recommends adapting the air pressure in the tires to the loads carried and the use of two-way hydraulic shock absorbers.

Einfluss der Achsmasse auf die Federungseigenschaften eines Fahrzeuges

By Rudolf Slaby. Published in *Automobiltechnische Zeitschrift*, Dec. 10, 1936, p. 593. [C-1]

By mathematical analysis of the movements of a vehicle passing over road bumps, the author supports his contention that, provided maximum acceleration of vibration be the criterion of suspensions, better suspension characteristics are obtained by increasing than by decreasing unsprung weight. Two conditions limit this conclusion; it applies only at high speeds and within the range of unsprung weight characteristic of current design. Better suspension characteristics can be obtained by decreasing unsprung weight very considerably, to a point unattainable in present-day practice.

ENGINES

Versuche an einem Luftgekühlten Sechszylindermotor mit Vollständig Geschölssener Luftführung

By W. Kamm, P. Riekert, F. Von Stotzingen and K. Schopper. Published in *Kraftfahrtechnische Forschungsarbeiten*, No. 4. [E-1]

The experimental development of an air-cooled engine in which the cooling air follows a predetermined course through a fully enclosed system is here described. Cylinder temperatures, fuel consumption and power determined by bench tests are reported.

10. Diesel-Fachheft

Automobiltechnische Zeitschrift, Oct. 25, 1936. [E-1]

Special issues devoted exclusively to automotive Diesel engines are published from time to time by *Automobiltechnische Zeitschrift*. The present issue, tenth of the series, contains articles on Diesel engine combustion, ignition characteristics of Diesel fuels, needle bearings in Diesel engines, fuel nozzles, special problems of low-compression Diesels, and descriptions of Saurer and Oberhänsli engines. These special numbers, the first of which appeared in 1932, are intended to give a cross sectional view of the current state of Diesel engine technique.

Determination des Lois d'Avance à l'Allumage – Leurs Variations – Leur Réalisation Pratique

By Pierre Prévost. Published in *Journal de la Société des Ingénieurs de l'Automobile*, December, 1936, p. 389. [E-1]

The laws governing spark advance are discussed with a view to their practical application. The effect of the following variables is briefly reviewed: compression ratio; fuel characteristics, particularly octane number; engine speed; throttling; engine temperature; spark plug characteristics; air-fuel mixture ratio and engine condition.

In the author's opinion, three types of spark timing control should be provided; automatic, manifold depression and manual. He concludes also from his study that for any given engine optimum spark timing is not controlled by a definite law, but lies within a certain zone; and that spark advance is a method of controlling detonation and should be utilized as such.

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HIGHWAYS

Sense and Safety on the Road

By Robbins Battell Stoeckel, Mark Arthur May and Richard Shelton Kirby. Published by D. Appleton-Century Co., Inc., New York, 1936; 293 pp., illustrated. [F-3]

This book is designed for the average citizen interested in cooperating toward a reduction of accidents on the highways. It is intended for engineers, traffic experts or specialists.

The authors trace the historical development of the automobile and review its social and industrial effects on our daily lives. Devices for promoting highway safety are described.

Special attention is given to the driver covering such factors as his fitness, personality, selection, driving habits, training and discipline.

Motor traffic laws, automobile accident problems and statistics each are given separate chapters.

In closing, the authors recommend a seventeen-point safety program.

MATERIAL

Treibgasbetrieb in Kraftfahrzeugen

Published in *Automobiltechnische Zeitschrift,* Nov. 10, 1936, p. 549. [G-1]

The year 1937 will see a new type of domestic automotive fuel in use in Germany, gaseous fuels, most important among them being propane-butane blends; and this type is expected to fill 6 per cent of the total demand. In addition, an increase in the amount of German-produced petroleum fuels will bring the percentage of domestic automotive fuels from 53 per cent of the total consumed in 1935 to 74 per cent in 1937. Physical characteristics of gaseous fuels are set forth and the tank, piping and pressure control equipment needed in their use in automobiles is described.

Untersuchung des Verbrennungsvorgangs Deutscher Schweröle in einer Versuchsbombe

By Reinhard Muller. Published in *Kraftfahrtechnische Forschungsarbeiten,* No. 3. [G-1]

Bomb tests are made of the combustion characteristics of German Diesel fuels. The conclusion is drawn that ignition lag is a reliable index of Diesel fuel combustion characteristics. Recommendation is made that a standard testing machine and procedure should be developed.

Les Renseignements que Peuvent Fournir aux Constructeurs les Recherches Actuelles sur l'Oxydation des Melanges Carburés

By M. Prettre. Published in *Journal de la Société des Ingénieurs de l'Automobile,* December, 1936, p. 400. [G-1]

Factors controlling the speed of oxidation, and hence susceptibility to detonation, of carbureted fuel-air mixtures are scientifically summarized. They are, in general, pressure, fuel-air mixture ratio, temperature, presence of inert gases, and dimensions and nature of surface of combustion space; and, in addition, for the engine specifically, lack of homogeneity, turbulence, cylinder-head temperature, and radiations due to combustion.

The effectiveness of tetraethyl lead as an anti-detonant is shown to be limited by temperature, pressure and the nature of the fuel to which it is added. The author deduces from his discussion that tests to determine fuel octane numbers should be made not on one engine functioning under definite conditions, but on many engines differing widely from one another. He also prophesies that research being carried out on the nature and speed of chemical reactions will improve detonation characteristics of carbureted fuels only to a limited extent, but will open up numerous and vast possibilities for the improvement of ignition-lag in Diesel fuels.

MISCELLANEOUS

Handbook of Engineering Fundamentals

Edited by Ovid W. Eshbach. Published by John Wiley & Sons, New York and Chapman & Hall, London, England, 1936, 1081 pp., illustrated. [H-3]

This new handbook has been prepared for the purpose of embodying in a single volume those fundamental laws and theories of science which are basic to engineering practice, and is essentially a summary of the principles of mathematics, physics, and chemistry, the properties and uses of engineering materials, the mechanics of solids and fluids, and the commonly used mathematical and physical tables, to which has been added a discussion of contractual relations.

Mechanical Engineers' Handbook Vol II – Power

Eleventh Edition rewritten by Robert Thurston Kent. Published by John Wiley & Sons, Inc., New York and Chapman & Hall, London, England, 1936, 1254 pp., illustrated. [H-3]

A revolutionary change has been made in this, the eleventh edition of the well-known handbook. Its content is now divided into two

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sections, one dealing with the entire field of power and its applications that is of interest to the mechanical engineer, the other covering in detail present-day methods in design and shop practice, and each section occupying an entire volume. There are seventeen sections in the Power volume, followed by a complete index.

Diesel Engineering Hankbook

Edited by L. H. Morrison. Published by Diesel Publications, New York City, 1936, 824 pp. [H-3]

Diesel Publications, realizing that due to its unique relationship to the entire Diesel industry and to the long field experience of its technical staff it was in a position to serve those interested, has collected, edited and set in type the information and experience of its staff, and to insure completeness of the data, called upon various authorities in all branches of the industry.

PASSENGER CAR

Gerauschfragen bei Kraftfahrzeugen

By W. Kamm and O. Hoffmeister. Published in *Kraftfahrtechnische Forschungsarbeiten,* No. 3. [L-1]

The physical and physiological aspects of automobile noise are discussed. Instruments for sound measurement as adapted to automotive research are described, results of such measurements presented and recommendations made as to methods of noise prevention.

Untersuchung der Formsteifigkeit eines Selbsttragenden Wagenkörpers in Schalenbauweise

By W. Kamm, P. Riekert, and W. Krautter. Published in *Kraftfahrtechnische Forschungsarbeiten,* No. 4. [L-1]

Model tests are made to show the comparative rigidity of a conventional automobile frame and a vehicle embodying a body and chassis combined in a monocoque type of structure. Favorable conclusions are drawn as to the latter, the main design features of which may, it is said, be developed through model research. Full-scale tests will then be needed to determine its road behavior.

La Voiture du Plus Grand Nombre

By Pierre Maillard. Published in *La Vie Automobile,* Jan. 10, 1937, p. 5. [L-1]

What single chassis model, which could be fitted with various types of body for various services, would fill the requirements of the majority of prospective automobile buyers in France?

In answer to this question, the author specifies the following characteristics: ability to carry a payload of about 1000 lb., corresponding, for a passenger-car, to a capacity of 5 seats; 114 in. wheelbase, 53 in. tread; for standard body, a streamlined, all-metal four-door sedan, without running-boards and with ample baggage capacity; maximum speed, 65 m.p.h.; four-cylinder, 120 in., 45 hp. engine; rigid frame; four-speed transmission and independent front-wheel suspension.

Neuzeitliche Werkzeugmaschinen im Automobilbau

Published in *Automobiltechnische Zeitschrift,* Nov. 25, 1936, p. 561. [L-5]

A questionnaire to machine tool builders in Germany brought forth the information here presented on the recent development of machine tools for the rapidly growing automotive industry of that country. The efficiency of standard tools is said to have been increased and a number of special-purpose tools designed. Both types are said to be capable of easy adaptation to dimensional and quantity changes called for in annual production schedules.

I. – Lois Regissant l'Industrie Automobile dans ses Rapports avec les Prix de Vente et les Impots.
II. – Determination d'une Politique Economique de l'Automobile. – Ses Incidences Fiscales

By J. Andreau. Published in *Journal de la Société des Ingénieurs de l'Automobile,* November, 1936, p. 351. [L-6]

A statistical analysis, illustrated by graphs, is made of the automobile industry in France, Great Britain and the United States, extending back for certain points to 1915, for others to 1930, and including for others forecasts to 1940. The phases covered are: the number of vehicles in operation; production; relation between the number of vehicles in operation and annual production; the relation of production to special automobile taxes and to selling price; annual fuel consumption per vehicle and distribution of current taxes paid by the automobile.

That the automobile industry in France is in even more tragic situation than superficially appears to be the case is the conclusion drawn from this analysis.

Recommendations made include: reducing the tax on liquid fuels; subsidies by the Government to increase production 50 per cent over that of 1935 and reduce selling price by 25 per cent, a measure which, it is claimed, would enable the automobile industry to absorb unemployment; and regulation of sales by qualified representatives and engineers.

Hang Your Certificate!

President Harry T. Woolson says:

"Hanging our certificates of SAE membership prominently on the walls of our offices is a way of putting up our flag and showing our colors.

"That certificate is something to be proud of. Won't you get yours framed and hang it up—if you haven't already done so?"*

***If your certificate is lost, strayed, or stolen, write to SAE Headquarters.**

About SAE Members:

J. H. Nead, chief metallurgist, Inland Steel Co., has been appointed a member of the Iron and Steel Division of the SAE Standards Committee.

Arthur Nutt, vice-president in charge of engineering, Wright Aeronautical Corp., spoke on "European Aviation Engines" at a recent meeting of the Institute of the Aeronautical Sciences, Wright Field, Dayton.

William M. Holaday has joined the Socony-Vacuum Oil Co., New York, as automotive research engineer. He previously held a similar position with the Standard Oil Co. (Ind.).

E. D. Herrick, former chief engineer, Lycoming Manufacturing Co., has been elected president. He has been long affiliated with Lycoming and at the time of his election was assistant general manager.

E. D. Herrick
Elected President

Maj. M. V. Brunson, Quartermaster Corps, U. S. Army, now attending the University of Michigan, has been ordered to duty effective in June to the Quartermaster General's Office, Washington, D. C., where he will be assigned to the War Planning and Training Section.

Dr. Miller McClintock, director, Harvard Bureau for Street Traffic Research, and in active charge of window display research of the Advertising Research Foundation, is scheduled to address the annual meeting of the Lithographers National Association at White Sulphur Springs, West Va., May 11-13.

Fred S. Kramer has been appointed lecturer at Pretoria Technical College, Pretoria, South Africa. He was formerly sales engineer with Pilot Tool & Machinery Co., Pty., Ltd., Johannesburg, South Africa.

Charles F. Kettering, general director of General Motors' research laboratories, was made a member of the Legion of Honor by Count Charles de Ferry de Fontnouvelle, French Consul General, of New York acting on behalf of his Government. Mr. Kettering was so honored for his work in developing the hypertherm, an air-conditioned box designed to induce artificial fever in curing certain diseases. Membership was conferred during the First International Conference on Fever Therapy in New York early last month.

Dr. F. C. Reggio, research engineer, Compagnie Lilloise des Moteurs, arrived in the United States early in April to study Diesel engine construction in this country. Dr. Reggio's company holds the right to manufacture Junkers Diesel Engines in France.

William B. Stout, president, Stout Engineering Laboratories, Inc., addressed the National Association of Real Estate Boards' regional convention in Omaha, Neb., April 8-9. He spoke on the discoveries made by the trailer industry in the field of home construction.

John Burt Flynn has been garage superintendent for J. Kitchen & Sons, Ltd., soap manufacturers in Sydney, Australia, since Feb. 1. He was previously aircraft engineer, Holden's Air Transport Service, Ltd., New Guinea, British East Indies.

Walter A. Graf, formerly assistant engineer, Edward G. Budd Manufacturing Co., Philadelphia, has been transferred to that company's Detroit plant where he has assumed the duties of chief draftsman of body engineering.

William S. Knudsen, General Motors' executive vice-president, is personally introduced to readers of the April 17 issue of the *Saturday Evening Post* by Charles Wertenbaker. "He is no longer a laborer, but he is still a worker; he has always got along with other workers, and he still does," says Wertenbaker.

Bruce G. Leighton, former vice-president Curtiss-Wright Export Corp., has joined the Intercontinent Corp., as vice-president. Offices of both companies are in New York.

Bruce G. Leighton
To Intercontinent Corp.

Brint Edwards, who has been draftsman with Atlas-Imperial Diesel Engine Co., Oakland, Calif., recently joined the Douglas Aircraft Co., Inc., Santa Monica, in a similar capacity.

Dr. Robert E. Wilson
Heads Oil Companies

Dr. Robert E. Wilson has been elected president of the Pan American Petroleum and Transport Co., The American Oil Co., and their various subsidiaries. Since 1935 he had been vice-chairman of the board. Active in research work since receiving his B.S. degree from M.I.T. in 1916, Dr. Wilson has devoted considerable study to vapor pressures, war gas absorbants, flow of liquids, lubrication, physical properties of hydrocarbons, petroleum chemistry and corrosion. He is author of some 60 papers and holds about 50 patents on these and other subjects. Prior to his affiliation with the Pan American Petroleum and Transport Co., Dr. Wilson was vice-president in charge of research and development, Standard Oil Co. (Ind.), with which he had been connected for 12 years. He was a member of the SAE Council in 1932-1933.

Dr. George W. Lewis has been appointed to serve on the Guggenheim Medal Board of Award as a representative of the SAE, replacing Admiral E. S. Land, whose term has expired. C. H. Chatfield and T. N. Joyce are SAE representatives whose terms are continuing.

Richard R. Bloss has been made vice-president and general manager of the International Derrick and Equipment Co., of Texas, with headquarters in Beaumont. He was formerly vice-president, International-Stacey Corp., Columbus, Ohio.

Harry I. Hazzard, formerly assistant engineer, Fort Wayne Works, International Harvester Co., has joined the engineering staff of the American Bantam Car Co., Butler, Pa.

Frederick C. Brandt has joined the Reynolds Engineering Co., Rock Island, Ill., as designer. He was previously junior engineer, City of Detroit, Department of Water Supply.

John A. White, recently vice-president and general manager of the Auto Cruiser Sales Corp., Baltimore, has returned to the Mack Truck Co., Atlantic Central division, as manager, wholesale department. When previously with Mack he was manager of the Harrisburg branch for two years and of the Baltimore branch for ten years.

Autocar Changes

Charles E. Doling, vice-president of The Autocar Sales & Service Co., has been appointed sales manager of the company's New York district. *J. B. Rosenquest,* formerly manager of the Newark Branch, has been made manager in charge of Autocar's newly formed northern New Jersey district.

. . . . At Home and Abroad

Sydney G. Tilden, president, S. G. Tilden, Inc., has been appointed, by the Council, as the Society's official representative on the Automotive Educational Commission of the Advisory Board on Industrial Education.

M. E. Clark, formerly sales engineer, air conditioning department, Drying Systems, Inc., Chicago, recently has been appointed sales manager of the Randall Graphite Products Corp., also of Chicago. This marks his return to the automotive field with which he previously was identified for more than ten years.

Del S. Harder has been named general factory manager for all fabricating divisions of Fisher Body. Prior to this appointment he was resident manager of the Grand Rapids stamping division of General Motors.

C. M. Hogarth, hitherto district sales manager, Autocar Sales and Service Co., Baltimore, has been appointed manager in charge of Autocar's new southern district which includes branches at Salisbury, Md., Norfolk, Va., and Charlotte, N. C. Mr. Hogarth's headquarters will be in Richmond, Va.

Millard C. Rowley has joined the Lycoming Manufacturing Co., Williamsport, Pa., as analytical engineer. He was previously engineer with Bendix-Westinghouse Automotive Air Brake Co., Pittsburgh.

Edward Paul Holleran, former instructor, Cass Technical High School, Detroit, recently joined George F. Quigley, Inc., Detroit, as sales engineer.

Harold S. White, formerly laboratory engineer, Studebaker Corp., has joined the Olds Motor Works, Lansing, Mich., as development engineer.

George L. Appleyard is partner of Appleyard and Baillie, automotive safety service, Lawrence, Mass. He was previously service manager, Robinson-Toohey Co., also in Lawrence.

Donald D. Waller is test engineer, senior grade, with Consolidated Aircraft Corp., San Diego, Calif. He was formerly design engineer, AC Spark Plug division of General Motors Corp., Flint, Mich.

David E. Anderson, chief engineer, Bohn Aluminum and Brass Corp., is author of "Let's Take a Step Forward in Engine Design," an article appearing in the March 27 issue of *Automotive Industries.*

E. L. Carroll, eastern advertising manager, SAE Journal, has been elected president of Volunteer Fire Department No. 2, of Scarsdale, N. Y.

A. O. Payne recently joined the Schwarze Electric Co., Adrian, Mich., as chief engineer. He was previously president and general manager of the Payne Engineering Corp., St. Louis, Mo.

Earl S. Gray has joined the Texas Co.'s research laboratory staff at Beacon, N. Y. He was formerly sales and service engineer with E. A. Wildermuth, Brooklyn, N. Y.

Pierre Schon, transportation engineer, General Motors Truck Co., addressed the Traffic Club of Sioux City, Iowa, March 24. He discussed manufacturers' and operators' problems relating to regulation, taxation, operating economics and highway safety. Mr Schon is chairman of the SAE Transportation and Maintenance educational subcommittee.

David Beecroft, Bendix Products Corp., attended the eighth Annual Convention of the Greater New York Safety Council, April 13-15, as official SAE representative.

M. H. Bauer, group leader, technical office, German Air Ministry and commodore of the German Motor Boat Federation, has been appointed American Power Boat Association honorary vice-president for Germany.

Establishes Foundation

Underwood & Underwood

Alfred P. Sloan, Jr., president of General Motors Corp., has established a foundation to aid economic research. It will be personally endowed by Mr. Sloan, whose name it will bear. The foundation will not set up its own research organization but will underwrite projects to be handled by established institutions.

William Edward Hann, formerly a member of the firm of Harness, Dickey, Pierce & Hann, Detroit, has announced the opening of offices in Los Angeles, where he will continue the practice of United States and foreign patent and trade-mark law. Mr. Hann has been Graham-Paige's patent counsel for the past several years.

E. H. Kelley has been promoted to the position of assistant production engineer for Chevrolet Motor Co. Mr. Kelley's work relates primarily to contacts between the central office and the production plants. He is chairman of the Detroit Section's plant representatives group for 1936-1937.

George J. Higgins, associate professor of aeronautical engineering, University of Detroit, recently received his commission as lieutenant commander, United States Naval Reserve, special service, aviation division. He joined the University of Detroit faculty in 1928, following five years with the National Advisory Committee for Aeronautics.

Frederick W. Heckert is sales and service manager, Romec Pump Co., manufacturers of aircraft fuel pumps and accessories, Elyria, Ohio. He was formerly with the Parker Appliance Co., Cleveland.

Stuart H. Caldwell, formerly with Kelch Heator Co., Detroit, is sales engineer with Ingersoll Steel & Disc Co., division of Borg-Warner Co., Chicago.

Ray F. Kuns, principal of the Automotive Vocational High School, Cincinnati, and editor of *Automobile Digest,* has recently published the second edition of his book, "Trailer Engineering." The first edition was published in 1934.

A. C. Hoof, president, Hoof Products Co., Chicago, is on a vacation tour through Mexico. Writing from Mexico City he reports that the building of hard roads in that country is increasing and that already the beneficial effect of the new national highway from Laredo, Texas, to Acapulco, on Mexico's Pacific coast, has stimulated the sale of automobiles and accessories along the line of travel.

John I. Cicala, former laboratory test assistant, Chevrolet Motor Co., Detroit, is now with the Socony-Vacuum Oil Co., in Brooklyn.

William Hamlyn Welch has been made manager and chief engineer, spark-plug division, Bowes "Seal Fast" Corp., Indianapolis. He was formerly automotive engineer, Standard Oil Co. of Indiana.

Everett V. Allen has joined the Oliver Farm Equipment Co., Charles City, Iowa, as draftsman. He was formerly junior engineer, International Harvester Co., Pullman plant, Chicago.

Dr. Ing. Ferdinand Porsche, German consulting engineer who has been responsible for the Auto Union racing cars, is designing a car which will attempt to better the land speed record now held by Sir Malcolm Campbell. The speed tests are scheduled for the summer of 1938.

George O. Pooley has discontinued his practice as consulting automotive engineer in Baltimore and is now affiliated with Mack-International Motor Truck Corp. He will be located in Philadelphia. Mr. Pooley is past-chairman of the Baltimore Section and last year was chairman of the SAE Membership Committee.

George O. Pooley *With Mack Truck*

Vernon I. Shobe

Vernon I. Shobe, a member of the Society since 1915 and long affiliated with the automotive industry, died April 7 at the Simpson Memorial Hospital, Ann Arbor, Mich., following an illness. At the time of his death Mr. Shobe was vice-president and general manager of Leibing Automotive Devices Co. Before joining that company three years ago, he had been affiliated with Zenith Carburetor Co. since 1912, serving successively as sales engineer, New York branch manager, sales manager and general manager. His first automotive contact came in 1907 when he was engaged as tester by the Welch Pontiac Motor Co. Mr. Shobe, who was 52 years old, is survived by his wife and a daughter.

News of the Society

Field Editors

Baltimore	Espy W. H. Williams
Buffalo	O. A. Hansen
Canadian	Warren B. Hastings
Chicago	Austin W. Stromberg
Cleveland	William G. Piwonka
Dayton	Mearick Funkhouser
Detroit	Frank J. Oliver
Indiana	Harlow Hyde
Kansas City	No Appointment
Metropolitan	Leslie Peat
Milwaukee	Max Hofmann
New England	J. T. Sullivan
No. California	C. W. Spring
Northwest	R. J. Hutchinson
Oregon	Philip Cogswell
Philadelphia	Henry Jennings
Pittsburgh	Murray Fahnestock
St. Louis	C. T. Schaefer
So. California	W. G. Chamberlin
So. New England	John G. Lee
Syracuse	No Appointment
Washington	R. E. Plimpton

SAE Delegates Sail to Attend World Congress

Sailing for Paris early this month SAE Vice-President for Fuels and Lubricants C. H. Baxley, Socony-Vacuum Oil Co.; Dr. George Calingaert, Ethyl Gasoline Corp.; and C. B. Veal, SAE Research Manager, will represent the Society at the Second National World Petroleum Congress to be held in that city, June 14-19. SAE Councilor Alex Taub, Vauxhall Motors, Ltd., England, and T. A. Weir, Socony-Vacuum Oil Co., Paris, who will also represent the Society, will join the United States' delegation at the Conference.

Papers will be read by Mr. Baxley, Dr. Calingaert and Mr. Veal. The paper to be read by Mr. Baxley is one that he has prepared jointly with J. P. Stewart, of his company, titled, "Methods and Equipment Used in the Development of Lubricants for High Output Service with Special Reference to Aviation Oils." Dr. Calingaert will read a paper prepared jointly by S. D. Heron and Ferd Gillig, both of Ethyl Gasoline Corp. Its subject is "Supercharged Knock Testing."

Also a representative of the Cooperative Fuel Research Committee, Mr. Veal, as its secretary, will present a paper entitled, "Cooperative Research and Standardization for Automotive Petroleum Products in the United States."

Free-Wheeling Not Dead, Gearset Expert Claims

• Canadian

Free-wheeling has *not* passed out of the picture, argues S. O. White, chief engineer of Warner Gear, even though it is not now widely advertised. It is a part of the automatic overdrive, he pointed out to the Canadian Section at its March 17 meeting in Toronto, and is the reason for easy engagement. Because the shift into overdrive locks the free-wheel, however, this removes one of the chief objections to free-wheeling as formerly applied, according to Mr. White, since the car will now coast against the engine when driving at touring speeds.

Changes in design of the transmission itself have not been commensurate with the amount of work done on these units, in Mr. White's opinion. "Learning a great deal about what not to do" has been the chief result of the intensive transmission work of recent years, he announced, stating that "an immense amount of negative information has been accumulated." He added, however, that:

"Our present transmissions are essentially what they have been for years past. Their quality has greatly improved, they are smaller, quieter, more efficient, but not different in principle. . . . We hear startling rumors from time to time, and even see interesting and often apparently workable transmissions illustrated and described, but none of them has, as yet, gotten into important production."

To move the control to somewhere else than its past standard position or to do away with it entirely is one line of thought upon which progress has been made, Mr. White pointed out, but showed that such changes leave the transmission itself the same as before.

The answer to a top ratio for overdrives practically as quiet as direct was finally found in a refined and accurately made planetary system, he stated. As a result of the success of this in large quantity production, great activity has been generated in development of planetary trains, in a wide variety of transmission schemes, usually automatic.

Reiterating his previously expressed ideas about the possibilities of automatic transmissions for widespread passenger car use, Mr. White said: "The opinion seems to be fairly general that a fully automatic device would not give a satisfactory and safe drive, but that more or less of manual driver control should be retained."

"As everything on our automobiles is more or less of a compromise," he concluded, "perhaps we could gain most of what our automatic transmission promises, in some less radical and expensive way and with means already at hand and tried out."

The Canadian Section learned about the value of salesmanship in engineering on April 16 when it was addressed by F. B. Willis, vice-president, Bendix Products Corp. Members and guests numbering 250 came to the Prince Edward Hotel to hear Mr. Willis and were welcomed by Wallace R. Campbell, president, Ford Motor Co. of Canada.

Max Evans, Canadian Section chairman, presided at a brief business session with which the meeting was opened and Vice-Chairman W. E. McGraw welcomed SAE President Harry T. Woolson who outlined briefly the contribution which the SAE is making in the development, extension and elaboration of civilization.

Mr. Willis was introduced by John D. Mansfield, president, Chrysler Corp. of Canada.

Airline Maintenance Procedure Described

• Northwest

When the United Air Lines was formed it was a merger of several independent lines and consequently it first operated with several different types of airplanes, R. B. Burnett, chief mechanic, Seattle station of that company, told the Northwest Section at its March 26 meeting. Later, he explained, this equipment was discarded and a standard airplane placed in service on all routes.

After this introduction to his paper, "Maintenance of Transport Airplanes," Mr. Burnett described the system of maintenance put in force when the equipment was standardized. A central overhaul-and-repair base was established at Cheyenne, Wyo., and other inspection and maintenance shops were set up at key cities along the various routes. All maintenance work, he said, is done at the key-city shops, although each ship goes to the overhaul-and-repair base for a complete overhaul at regular intervals.

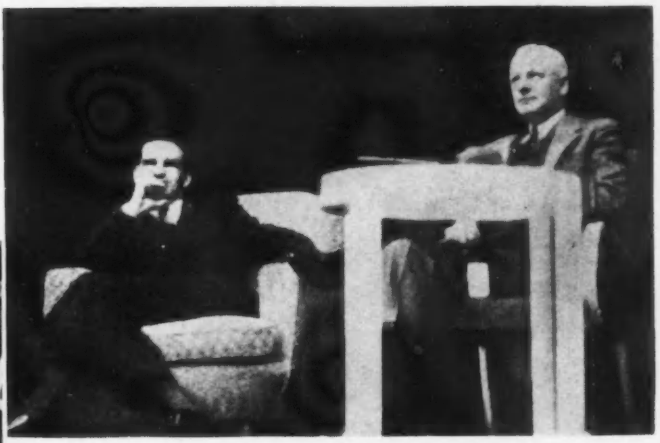
There is no compromise with safety at any of the stations, he declared, because constant vigilance over equipment is characteristic of every maintenance operation. All stations carry a complete set of parts and are able to replace any doubtful part immediately, he explained, stating further that whenever a part is removed it is tagged with information pertaining to its condition and at once sent to Cheyenne where a new part is issued to take its place in station stock.

The speaker continued by describing operation of modern airplane refinements, particularly forced lubrication to rocker-arm bearings, automatic mixture control and the controllable-pitch-propeller governor. The mixture control and governor, he said, work together to hold engine speed constant regardless of altitude.

Among those entering the discussion were A. J. Lilygren, Bendix Products Corp.; H. W. Drake, Pacific Highway Transport Co.; J. G. Holmstrom, Kenworth Motor Truck Corp.; and W. W. Burrington, Northwest Air Service. Mr. Burrington and Roy Ellis of United Air Lines were guests of the Section.

Candid Shots at Southern California Meeting

Section Chairman L. J. Grunder (left) and Meeting Chairman Stanley Whitworth enjoy the papers.



Photos by SAE Journal Field Editor W. G. Chamberlin

"Industry is too prone to stick to traditions," says Past-President William B. Stout.

182 Hypoid Lubricants Approved by Chevrolet

● Chicago

"As a result of proving-ground scoring tests supplemented by laboratory tests over a seven months' period, 182 hypoid lubricants have been placed on our approved list," announced C. E. Zwahl, metallurgical engineer, Chevrolet Division, General Motors Corp., in his paper, "Hypoid Lubricants – Results of Tests and Their Interpretations by Chevrolet Motor Co.," at the April 6 meeting of the Chicago Section, which was attended by 192 members and guests.

Seeking to correct an impression that may have been created by earlier tentative specifications – that only lead soap-active sulphur and lead soap-sulphur saponifiable-chlorine lubricants would be considered, Mr. Zwahl stated, "If there are other lubricants than these two types which will lubricate our axles satisfactorily, we want to know about them and will place them on the approved list if they pass our tests."

Nine different characteristics are checked in the laboratory tests, he reported: load-carrying properties; viscosity; chemical analysis to determine the total lead, sulphur, and chlorine; oxidation; evaporation loss; non-combustible sediment; channeling; foaming; and copper-strip test.

Scoring tests are conducted over a 3.8-mile speed loop in the proving ground at speeds varying between 10 and 70 m.p.h., continued Mr. Zwahl, and a new third member is used for each test of each lubricant. If gears are scored, the test is discontinued immediately and the lubricant is given no further information, he announced, but, if the gears are not scored, a second third member with a fresh refill of the same lubricant in the cleaned housing is tested similarly. If the lubricant prevents scoring in the two tests and is free from certain undesirable characteristics as determined in the laboratory tests, it is considered satisfactory, he concluded.

In the remainder of his paper, Mr. Zwahl discussed hypoid lubricants that failed to pass the tests and durability tests on various hypoid lubricants covering mileages up to 40,000.

Pointing out that the data reported agree with the General Motors Tentative Specifications for Hypoid Lubricants on but two out of eight counts, Dr. D. P. Barnard, Standard Oil Co. of Ind., suggested that merely specifying the necessary viscosity limits and requiring that proving-ground or other service tests must be passed, and publishing the other items for information only, would seem to be a better policy since the lubricant manufacturer has no means for obtaining the necessary service information.

Support for Mr. Zwahl's conclusion that hypoid oils must have a high active sulphur content to prevent scoring was given by W. H. Oldacre, D. A. Stuart Oil Co., Ltd., in prepared discussion, drawing from 8 years' experience in this work. However, he does not believe the assumption that hypoid oils must have an appreciable lead-soap content is nearly as well supported either by proving-ground or by practical experience.

To illustrate the progress made in hypoid lubricants, A. W. McCalmont, Sinclair Refining Co., recalled how few acceptable lubricants were available a short time ago and pointed out that today they come from 52 different sources and are marketed under 160 different brand names. He reported examples of transmissions that operate at temperatures of 240 and 250 deg. fahr. without a great deal of oxidation.

"Lubricants that pass the 'bump' test, without exception after careful physical and chemical analysis, lack one or more vital characteristics, such as stability under service and storage conditions," believes Joseph A. Moller, Pure Oil Co., "they are therefore not selected from a point of view of a lubricant, but from that of performing anti-weld functions only," he concluded.

Harry O. Mathews, Public Utilities Engineering & Service Corp., wound up the discussion by presenting an operator's side of the problem. He stressed the need for hypoid lubricants that will run 25,000 miles without sludging.

Section Chairman Fred L. Faulkner introduced SAE Past-President Ralph R. Teetor, who said a few words. V. P. Rumely, 1936-1937 Chairman of the Detroit Section, who has recently taken up new work in Chicago, and is now a member of the Chicago Section, was also introduced.

Taub to Represent SAE At London Conference

When the British Institution of Mechanical Engineers holds its General Discussion on Lubrication and Lubricants in London this October the Society will be represented by SAE Councilor Alex Taub of Vauxhall Motors, Ltd., England. Mr. Taub's appointment was made at the last meeting of the Council.

It is expected that this discussion will be a two-day meeting and that some 100 papers will be presented by authorities from all parts of the world.

Orr and Stout Address Passenger-Car Session

● So. California

"If only those cars more than 8 years old were retired during 1937 there would be more than 4,470,000 new cars sold just to replace them. If all cars over five years old were replaced this figure would jump to 9,666,000." These statements were made by G. Verne Orr, sales manager, Chrysler Motors of Calif., who shared Southern California Section's March 25 meeting program with SAE Past-President William B. Stout, president, Stout Engineering Laboratories.

Stanley Whitworth, chairman of the Section's Passenger Car Activity Committee, introduced the speakers to the 145 members and guests attending this annual Southern California Section passenger-car session.

Interesting statistics permeated Mr. Orr's talk. Last year, he said, a total of 310 new cars and 560 used cars were sold each day in Los Angeles County; more than were sold in the five surrounding states.

Mr. Orr recalled that there have been 1501 different makes of cars built since 1895 of which only 11 makers remain manufacturing cars bearing 23 different names. "Those manufacturers who have survived," he stated, "have done so only through the quality of their products; the balance have fallen by the wayside in the age-old battle of survival of the fittest."

"Being radically different isn't a credit to anything; its a liability. Being radically *better* is a credit and a product that is such will sell itself," declared Mr. Stout, who also remarked, "industry today is too prone to stick to tradition." He added that the general attitude of industry is, "if we are selling more than we can make, why change?" Mr. Stout feels that it is up to the engineers to, "pick up the torch and, without regard to tradition, continue the work they have started so splendidly along modern modes of thought."

Stating that the public unintentionally designs motor-vehicles, Mr. Stout explained that every time a customer buys a car he casts a vote for that particular make and model, and it is through these votes that industry determines the public's preference.

He believes that the big problem facing the automotive industry is how to give the passengers additional room inside the car. Desire for more space, he declared, has caused the public to buy trailers.

Touching on the housing situation, Mr. Stout pointed out that during the last few years the nation has gotten 500,000 houses behind in its

building program. Using normal methods of building, he said, we can never catch up; some production-type of house must be developed to fill this need. Continuing, he said, that more than 80 per cent of the houses east of the Mississippi are unsuitable for modern tenancy. He believes that the design of the house as we now know it must be changed to take full advantage of modern household appliances.

After Section Chairman L. J. Grunder had closed the meeting, Mr. Stout's Scarab car and folding-house trailer were inspected by those attending.

Diesels Claimed Good On *Short* Haul Work

● Metropolitan

Reports of marked success in operating Diesel trucks for short haul work in city traffic startled Metropolitan Section members at their April 12 meeting. Discussions following the paper "Diesel Engines in Motor Trucks" by B. B. Bachman, vice-president of the Autocar Co., Ardmore, Pa., and a past-president of the Society, disclosed that hundreds of Diesel-powered trucks have proved successful in heavy city traffic. In one case, reported by C. D. Cummins and R. B. Rogers, Cummins Engine Co., Columbus, Ind., a contractor found that five Diesel units did work which heretofore required six gasoline trucks of the same size, largely because of increased acceleration after changes in traffic lights and better ability to negotiate steep grades. Mr. Bachman brought his annual meeting paper (see p. 173 TRANSACTIONS Section) up to date with additional operating data on one gasoline and two Diesel units.

O. D. Treiber, chief engineer, Diesel division, Hercules Motors Corp., Canton, Ohio, reported that his company had increased Diesel engine output from nothing three years ago to a rate of 500 shipped a month ago. Tooling for 50 units of one model a day has been completed.

Discussion brought out that a large percentage of Diesel truck installations to date had been made in old vehicles where gasoline engines had been replaced. Several Autocar, Mack, and White models are engineered for Diesel engines, which are installed at the factory.

Although, he said, first cost of Diesel powerplants, based on horsepower, is more than twice that of gasoline engines today, Mr. Treiber pointed out that savings in fuel costs made Diesel units far more economical in most transportation operations. However, on a displacement basis the cost of the engines is more nearly equal. Several Diesel manufacturers reported doubled output this year as compared with last year, with bright prospects for the future.

W. A. Parrish, chief engineer, Buda Co., Harvey, Ill., wrote that the economic desirability of the Diesel's reduced maximum firing pressure to a point at which the shock load of torque on transmission and rear axle is comparable to that of the conventional gasoline engine has been established.

In citing his company's experience with an admittedly "rough" Diesel engine, J. F. Winchester, manager of the automotive department, Standard Oil Co. of N. J., showed that it had failed to perform with anything like the success of gasoline engines. Not only was the engine replaced, but the new one is standing idle with a crank through the case.

George A. Round, chairman of the Section's Diesel activity, conducted the technical session following reports by J. A. Anglada, chairman of the Nominating Committee on nominees for the coming year, and Kenneth Campbell, on the work of the Membership Committee. C. Herbert Baxley introduced Mr. Round.

Manly Medalist Reviews Airplane-Engine Progress

● Cleveland

Over-weather flying will be made possible within the next few years by the variable-speed supercharger, the exhaust-turbo supercharger and supercharged cabins, said Raymond W. Young, assistant engineer, Wright Aeronautical Corp., in speaking before 200 Clevelanders at the Section's March 16 meeting. The supercharged cabins, he stated, will be maintained at comfortable air density and temperature by an engine-driven blower.

SAE President Harry T. Woolson and the Society's General Manager John A. C. Warner were the Section's guests at this meeting. Mr. Woolson, in a short inspirational talk, stressed a more powerful membership, accelerated standardization, intensified research, more vital technical papers and broader engineering relations as the objectives of the Society. Mr. Warner gave a vivid picture of the Society as it is today and emphasized its value to its members and the industry.

Mr. Young, who but a few days before had been awarded the Society's Manly Memorial Medal for his paper before the 1936 Annual Meeting, "Air-Cooled Radial Aircraft-Engine Performance Possibilities," continued his talk by outlining the developments of air-transport powerplants during the last ten years. During this period, he said, engine manufacturers have had as their objectives to (a) increase overall performance of the powerplant, (b) investigate and test properties of fuels and oils, (c) conduct research on cooling-air flow and cowling problems, and (d) coordinate powerplant installation with airplane manufacture to insure maximum performance of the engine-airplane combination.

Powerplant performance, he noted, has been increased during this period by changes in compression ratio, volumetric efficiency (including also supercharger efficiency), and adequate cooling, with the result that specific output of 0.28 hp. per cu. in. displacement in 1927 has been increased to 0.60 hp. in 1937.

Mr. Young also illustrated strides made by airplane-engine manufacturers in fulfilling their other objectives.

After a short discussion on Diesel engines in air service the speaker concluded with the observation that perhaps just as long as the conventional Otto cycle continues to progress as much as it has in the past, just so much more difficult will be its displacement from the heavier-than-air field of aviation by a different basic power unit.

Midgley Cites Past In Look at Future

● Washington

Transmission of intelligence and transportation are the two outstanding accomplishments of our age, in the opinion of Thomas Midgley, Jr., vice-president, Ethyl Gasoline Corp., who talked to over 100 members and guests of the Washington Section at the Cosmos Club, April 16.

Past President A. J. Scaife and Secretary and General Manager John A. C. Warner brought a word of greeting to the Section. Dr. H. C. Dickinson presided.

Despite the importance of transportation, Mr. Midgley said, the only new form to appear in the last 20 years is the military armor-plated vehicle called the tank. The preceding 20 years saw development of the automobile and the airplane. Asking the question, "Are we approaching the end of our mechanical age?" Mr. Midgley reviewed Spengler's philosophic analysis of previous ages, showed the rise and fall of various civilizations in the past and predicted corresponding behavior for those which have run but a part of their course.

We seem to be past the decline of religion and art developments, he said, and near the peak of the science curve. Misdirected and uncontrolled research, together with lack of coordination, he said, has a tendency to upset the economic structure and result in unpleasant consequences.

Dr. L. J. Briggs, in discussion, agreed that controlled research is necessary, but thinks that more and better coordinated research is necessary, particularly in the field of basic research – which he believes to be a national responsibility.

Dr. George W. Lewis referred to the improvement in aviation in the last 20 years and expressed himself as more optimistic than Mr. Midgley about what may be expected in the future. C. B. Veal urged the need for some human research to enable us to apply intelligently the fruits of material research. The physical has progressed beyond the mental side, he believes.

John Geisse confirmed Mr. Veal's expression and mentioned the medical researches now going on to determine the bounds of human endurance.

Dr. Dickinson emphasized the relation between reasearch and economics, and stated his belief that the cause of society reaching a stage where a few can produce enough for all – resulting in nothing for many to do – presents a problem in the mental and psychological field to keep us busy for a long time.

Data on Storage-Battery Life-Test Stands Ready

Just available are detailed drawings and a bill of materials for building the storage-battery-life-test stand described, with general information on the test procedure in the recently published 1937 SAE HANDBOOK. These consist of five sheets of general instruction, four sheets in the bill of materials and five drawings of general assemblies and wiring diagrams. These drawings supplement the data given on pp. 108-117 of the new HANDBOOK. The price for a single set is $2 (subject to change without notice) and orders will be filled by the Society on receipt of remittance. On orders of more than 25 sets reduced prices will be quoted.

SAE Sponsors Session On ASME Meeting Program

As co-sponsor of a general session on "Management and Mass Production," the SAE is participating in the semi-annual meeting of the American Society of Mechanical Engineers, Detroit, May 17-21. James H. Herron, ASME president, will be chairman of this session, to be held May 19. SAE Past-President John H. Hunt will be vice-chairman.

"The Decentralization of Industry" is the subject of the first paper which will be presented by William H. Cameron of the Ford Co. He will be followed by John W. Scoville, Chrysler Corp.'s chief statistician, who will speak on "Charting the Business Course."

SAE President Harry T. Woolson as chairman of the ASME Papers Committee has an active part in planning the technical program of the meeting. Other SAE members engaged in arrangements are C. R. Alden who is chairman of the Honorary Members Committee and Frank J. Oliver who heads the Recording Meetings Committee.

Members of the Society scheduled to participate in the program include: William S. Knudsen, Tracy V. Buckwalter, E. H. Piron, William L. Batt, Fred W. Cederleaf and C. R. Miller.

Progress of Diesel-Electric Trains Told By Henkle; Of Sleeper Buses by McCarroll

● Detroit

The new light-weight high-speed trains with Diesel-electric propulsion can negotiate a 1-deg. curve at 100 m.p.h. with safety and without discomfort to passengers, according to Thomas H. Henkle, Western sales manager, Edward G. Budd Manufacturing Co., who spoke before the Detroit Section on March 30. The meeting, which was also addressed by George McCarroll, vice-president, Sleeper Coaches, Inc., was originally scheduled for March 15, but was postponed when a sit-down strike occurred at the Statler Hotel.

The Budd company has succeeded in building trains that will run faster than tracks and operating conditions will often permit, Mr. Henkle stated. An important problem, he remarked, has been to efficiently stop these trains. Electrically-controlled air brakes have been devised with a governor that varies the air pressure, depending upon the speed of the train at the time the brakes are applied. In this connection, Mr. Henkle pointed out that while it requires 6000 ft. to stop a conventional steam train from 100 m.p.h., one of these light trains, with the new brake system, can be stopped in 3000 ft. When we consider, said Mr. Henkle, that all the energy required to accelerate trains to this speed in about 10 min. is dissipated in 40 sec., it is easy to believe that heat concentration is so intense that it causes shelling and thermal checks on the rims of the wheels.

Mr. Henkle mentioned that his company now has under construction a total of 81 cars built along the lines of "Shotwelded" stainless-steel construction. In fact, the whole success of the project, according to Mr. Henkle, depended upon the development of a technique for welding stainless steel without precipitating the carbides and thereby destroying the rustless properties at the point of the spotweld.

Mr. Henkle described two 10-car trains designed for service between Chicago and Denver which are powered by 3000-hp. Diesel locomotives built in two units. The leading unit has two 900-hp. Winton Diesels, each connected to a generator, and the second unit contains one 1200 hp. engine. There are eight electric traction motors for propulsion. These trains weigh 1,200,000 lb. each, and he declared, they are probably the fastest trains ever built. On the uphill run from Chicago to Denver they average 83.7 m.p.h., he stated.

With this welded-stainless-steel construction, Mr. Henkle pointed out, the cars are built into a truss, the roof being the compression member and the floor or underframe the tension member. The two are connected by box section posts and diagonals, most of which are tension members and complete the truss. The outside sheeting, Mr. Henkle explained, is light-gage corrugated stainless steel and does not carry any load.

Summing up, Mr. Henkle listed the following advantages of this type of equipment: higher average speeds due to faster acceleration and deceleration; greater safety to passengers because of reduced impact and the use of high tensile steel; greater riding comfort through the use of resilient springs and hydraulic shock-absorbers; cleanliness; greater availability as far as repairs are concerned; reduced operating costs for fuel and powerplant maintenance.

During the discussion, Mr. Henkle revealed that the only changes made in the road beds for the new high-speed trains have been slight increases in the elevations on curves. Rimmed flanges are standard, he said, and high-speed operation has not been found dangerous even when passing through switches. The treads of the wheels are originally turned cylindrical, but wear back toward the 1:20 tapered tread which is standard in steam railroad practice. Wheel bearings used in such high-speed service are anti-friction types.

T. F. Brackett, Fisher Body Corp., offered critical comment on attempts to use drum-type brakes on high-speed trains even for auxiliary braking. Shoes acting on wheel rims, he said, serve to keep the wheel round, their grinding action preventing the formation of flat spots. Experience with such brake drums has also presented problems in heat dispersion, he added.

Mr. McCarroll introduced his paper by noting that sleeper buses are a recent innovation. It was only by 1928 that the first sleeping vehicle was produced, he added. The constructor, he said, was Charles Wrenn, of Los Angeles, who for years had been a lone experimenter in the field. Later Mr. Wrenn built more than a dozen others. In describing these buses and ones subsequently built for his own company, Mr. McCarroll pointed out that the limitations on design are quite explicit, as intercity buses today must not exceed 33 ft. in length, 96 in. in over-all width and 12 ft. in over-all height. In fact, he added, in most Eastern states, the height cannot exceed 11 ft.

Mr. Wrenn succeeded in crowding 20 individual berths into his design, with an empty weight of nearly 20,000 lb. This compares with a bus carrying 36 passengers in individual reclining chairs. Through the use of Dowmetal, a magnesium alloy, Mr. McCarroll was able to produce a bus within the same dimensional limitations weighing 11,500 lb. empty, but carrying only 16 people in single berths. The same bus will carry 32 people comfortably seated. Berth-and-seat arrangement, said Mr. McCarroll, is modeled after the well-known Pullman. Passengers sleep longitudinally in eight compartments in upper and lower berths. He explained that the problems of heating and ventilation has been taken care of through a system of ducts which carries the heated intake air from the upper end of the bus into each berth.

For drive, Mr. McCarroll selected a Reo engine mounted longitudinally of the body at the rear. The transmission has been tied into the differential with drive to the rear wheels through slip-joint sliced axle shafts, he said, adding that each has two universal joints. A tubular dead axle, he continued, carries all the weight load and is a construction that provides a much lesser amount of unsprung weight.

Mr. McCarroll explained that his company has not adopted a pure chassisless type of construction, but utilizes an alloy frame 33 ft. long and weighing only 602 lb., compared with a standard steel frame weighing 900 lb.

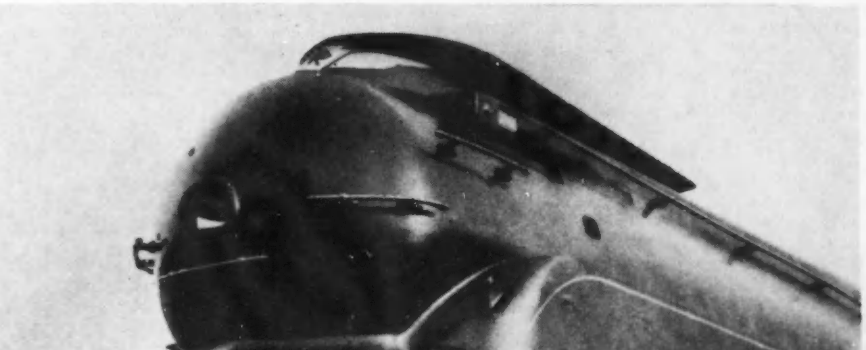
Student Branch Elects Officers for New Term

● Ohio State

Meeting on April 9 members of the Ohio State University elected officers to serve for the Spring quarter. Eugene E. McPherson, a senior, succeeds C. A. Hall as chairman. Roy J. Zook is the new vice-chairman. Virgil L. Iles and Richard W. Sutton are, respectively, secretary and treasurer. The Ohio State Student Branch elects a new set of officers each quarter.

(News continued on following page)

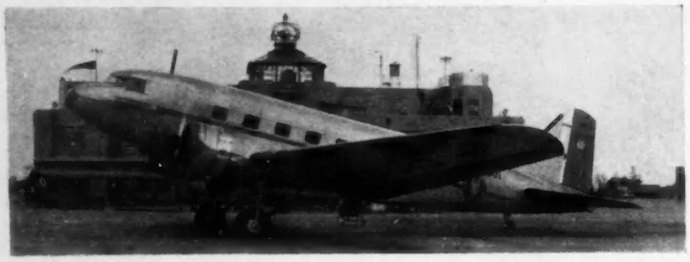
SAE Member Traces History of Locomotives



While SAE Sections in Detroit and Kansas City were getting the latest information on Diesel-Electric trains, the book, "Locomotive," by SAE member Raymond Loewy was being published. It is a pictorial study of locomotive developments in various countries, with comments by the author.

Mr. Loewy is pictured here with Pennsylvania Railroad's streamlined engine which he designed in conjunction with the P.R.R. engineering department.

Airport Visit Precedes Blind Landing Discussion



This plane, equipped with the Lorenz blind - landing system, was inspected by the Indiana Section before its April Meeting

Photo by F. M. Kirkpatrick and courtesy of International Tel. & Tel. Co.

Air Landing Signal Systems Are Argued

• Indiana

Capt. G. V. Holloman, Air Corps, Wright Field, opened the Indiana Section Blind Landing meeting with a concise description of the Army Signal Landing System with its two marker beacons mounted on two trucks placed at predetermined and always uniform distances from the field. He outlined the technique of following the radio glide path established by these beacons and the other data upon which the pilot has to depend – his height, speed, etc., above the beacons when he starts his glide. This system, along with the Bureau of Air Commerce system, and the German Lorenz system are now installed at the Indianapolis Municipal Airport for at least two months study by the Bureau, the Army and the several airline companies which use the field. The Army, incidentally, is employing in the tests a large amphibian with an experimental tricycle front landing wheel.

Dr. I. R. Metcalf, Bureau of Air Commerce, showed that in many respects all of the systems are developments and refinements of the original Bureau of Standards' system employing two marker beams and a more or less common form glide beam for the pilot to follow down from the outer beacon to the inner one, and then down to as nice a three point landing as he can figure out by watching a group of several instruments and keeping a half dozen other things in mind at the same time. The common factor of all systems to date has been the radio vocalizer that keeps the pilot informed by audible signals whether he is "on" or "off" the course. Many attempts have also been made to add visual signals to the vocalizer, but until recently this has not been done entirely satisfactorily. In the German built Lorenz system, however, (owned and controlled by the I. T. & T.) which is now set up for the first time in America there is a very good visual set of signals with a straight vertical marker in one instrument that is the "on" the course signal and a similar marker that swings repeatedly to the right or left if the pilot is "off" in the opposite direction and needs to swing in the direction in which the marker needle keeps swinging. While the Lorenz system has been used quite generally in Europe and is employed on thirty fields, it needs some modification for American use. It is now getting these modifications at the hands of its own experts at the Indianapolis Airport. Hard surfaced, and consequently fairly narrow, runways are not common in Europe. Here all commercial pilots use them more frequently than not and at the Indianapolis port all runways are concrete. It was found that the Lorenz beam needs sharpening and narrowing for best use here. Otherwise the pilot might miss the concrete. Our turf, of course, is not nearly as good as that found in many European fields.

Dr. Metcalf also described a system upon which the Bureau of Air Commerce is working in which it is hoped to give the pilot all the safe flying information he needs, once he is in his landing glide, through one visual instrument which, by keeping three dots of light horizontally on the cross hair of the instrument, will guide him down the path at the proper rate of descent with proper engine and airspeed, on an even keel. The three dots of light will give, when the system is finally complete, all the information the pilot now obtains from at least seven or more instruments.

How far instrument landing may go was brought out by Captain Holloman's answers to two questions. Wilbur Shaw wanted to know why the radio landing beam glide path might not be made into a straight line instead of a sloping curve, and the plane kept on a straight power glide; and why, if that could be done, couldn't we use automatic control for the whole thing. Captain Holloman differs with some instrument landing experts because he believes that we shall ultimately do just that, and, once we reach the landing beam at the proper approach height, turn the whole business over to the automatic pilot. All the technical experts here seem to be agreed that this is a place for utmost cooperation, the pooling of all knowledge and the working out of some final system very much more simple than anything we now know in practice. As one of the men said before the meeting "We are way past any personal pride of ownership or creation of any system or part of it. What we want is something that will do the trick simply, safely and with much more assurance and perfection than anything we know."

Bus Operator Talks on Preventive Maintenance

• Philadelphia

Over a hundred members and guests attending the April 14 meeting of the Philadelphia Section heard William J. Cumming, general superintendent of the Surface Transportation Corp., New York, give his ideas on "Preventive Maintenance as Applied to Automotive Engines, Transmissions, and Axles." J. B. Franks, Jr., White Motor Co., served as chairman of the meeting.

Mr. Cumming pointed out that the preventive-maintenance procedure in use by his company has been worked out over a period of years. In the first part of his paper, which was devoted to a description of engine inspection procedure, he commented, "severe operating conditions oblige us to maintain extremely high engine revolutions and extended periods of low and intermediate gear work. This results in abnormally high wear factors in cylinder bores, rings, wrist pins and bushings, and main and connecting-rod bearings.

"In fact, the condition becomes so serious with some engines that we would prefer to allot our engines for inspection on the basis of thousands of feet of piston travel, rather than on the basis of vehicle miles. Several attempts, however, to count engine revolutions have failed because of weak devices."

In the light of experience, Mr. Cumming mentioned that some design preferences had resulted, stating, "we much prefer timing gears to timing chains because of their inherently long life, and while they are perhaps more noisy at idling periods, when wear takes place, we find the extended life lends itself admirable to all our inspection periods.

"We prefer double fan belts to single fan belts, but better still, fans, gear driven; water pumps close coupled to the gear train with full length bearings; generators of low cut in rate and ample capacity; distributor drives of the magneto replacement unit type and gear reduction starters.

"We favor specially prepared connecting-rod bearings and main-bearing caps, which are poured and not spun, with the tinning carefully spread in V threads to give added adhesion."

In conclusion, Mr. Cumming pointed out that there is one item in all preventive maintenance schemes that should be brought to the attention of the vehicle manufacturers – the need for special tools to service modern automotive equipment, remarking, "we are quite sure all automotive equipment operators will agree these tools are much more essential to the successful maintenance of the equipment than jacks, common tool packs, extra rims and other materials usually included in specification lists."

Boosted Octane Numbers Seen Cutting Air Costs

• U. of Detroit

Lack of definite terminology in rating fuels on the iso-octane-heptane scale was lamented by J. J. Frey, Ethyl Gasoline Corp., at a joint meeting of the SAE University of Detroit Student Branch and the Aero Society on March 23.

Confusion arises in obtaining a standard octane number for a given gasoline, Mr. Frey pointed out, because different laboratories do not use a standard test.

High octane fuels, according to Mr. Frey, have been more than twice as effective in boosting the power output of the post-war aircraft engine as have improvements in basic design. As fuel goes higher up the octane scale, a small increase in octane number produces a tremendous increase of power, Mr. Frey stated. A 103 octane fuel will give as much as 40 per cent more power than a 100 octane fuel. Taking the "China Clipper" as an example, approximately \$2000 revenue per trip could be obtained for an added investment of \$200 in using 100

Newest Test Engine at White Sulphur

A new single cylinder crankcase construction for mounting full-scale aircraft engine cylinders, the whole constituting a prototype single-cylinder aircraft powerplant for use in testing fuels and lubricants, spark plugs, and so forth, is scheduled to make its first appearance at White Sulphur Springs during the Summer Meeting.

This crankcase unit has been built by the Waukesha Motor Company in response to the needs of several of the Society's research committees. It should result in making generally available for laboratory use an apparatus capable of operation at high speed and under conditions of both high output and temperature simulating, in a single-cylinder test equipment, conditions encountered in normal service operation of full-scale aircraft engines.

octane fuel instead of the present 87 octane fuel. Fuels in the 100 octane range will soon be here in large quantities, promised Mr. Frey.

A. Copeland, Wayne Country Airways Traffic Control, explained the control of air traffic at the Detroit city airport. The Airways Traffic Control organization itself maintains no radio equipment, Mr. Copeland said, but does have telephone connection with Department of Commerce radio stations. An itinerant pilot must submit a flight plan before starting from the Detroit airport and must follow his flight plan once it has been approved. He must obtain permission from the Airways Traffic Control before changing his altitude.

The organization's most difficult job, according to Mr. Copeland, is to get the confidence of the pilot. For that reason the Department of Commerce has appointed only experienced pilots to operate the Airways Traffic Control stations.

Human Nose Termed Original Air Filter

● No. California

"Air filters in commercial use are patterned after the one which nature has provided for all of us; namely the hair and membranes within the nasal passage. Human filters, however, incorporate one thing not yet included in commercial filters – an automatic warning device to inform us when servicing is needed."

With these remarks Prof. L. Boelter of the University of California, as chairman of the Northern California Section's April 13 meeting introduced the topics to be discussed – air cleaners and oil filters. Professor Boelter said that credit must also be given to nature for other filters; the liver, spleen, marrow and lymph – all of which purify the blood stream.

"Tractor Air Cleaner Performance in Dust Clouds," was discussed by Prof. F. A. Brooks, associate agricultural engineer, University of California.

Dust conditions, he said, vary from 0.001 gm. of dust per mile of travel on paved highways to conditions 4000 times as severe in construction work where clouds of dust are present practically all the time.

From contacts with vehicle operators Professor Brooks found that from their viewpoint the air-cleaner service period should correspond to the working shift of the vehicle or its lubrication and crankcase drain schedule. When it doesn't, he said, the air cleaner is apt to be neglected.

He stated that with the usual oil-bath type of cleaner an undue accumulation of dust will produce what he referred to as "dry holes" through which dirty air will pass without benefit of cleaning. Another bad feature of neglect, he said, is that the cleaner will load up while the engine is idling and then, upon the opening of the throttle, the vacuum which is built up will clean the filter at the expense of drawing the accumulated dust or dirty oil into the engine.

Professor Brooks remarked that some years ago he felt that centrifugal types of cleaners were of little value, but now he feels that they can be most beneficial under certain conditions; for example, as a pre-cleaner in a series with an oil-bath cleaner. In such a set up, he said, a good centrifugal cleaner will remove up to 95 per cent of the large dust particles and thus reduce the work of the oil-bath filter. This extends the servicing period, he added.

C. A. Winslow, consulting engineer, discussed "Oil Filters," the second subject on the program.

The oil filter is effective only when properly serviced, Mr. Winslow stated, explaining that there is a limit to the contamination which it will hold and, since uncleaned oil is better than no oil, all filters are provided with bypasses that send the unfiltered oil through the engine when the filter is clogged. Mr. Winslow deplored the use of small filters through which only a portion of the oil stream from the pump is circulated. Obviously, he said, such a filter cannot be counted upon to remove all the particles which might reach and damage bearings. As a more effective type he spoke of the filter of full-flow design placed in series between the pump and the bearings and capable of handling the full oil flow from the pump.

In concluding, Mr. Winslow described a filter designed primarily to make the servicing operation as convenient and simple as possible and equipped with a device that would light a lamp or ring a bell to warn the driver when the filter is in need of attention.

Among those discussing these two papers were G. L. Neely, C. F. Becker, H. F. Kley, R. H. Stalnaker, and E. C. Wood.

After the meeting several exhibits were inspected which showed examples of engine parts badly damaged because of lack of adequate filters. There were also demonstrations of a centrifugal air cleaner and an oil filter.

Washington Asks SAE Light Specifications

Rules and regulations on headlight equipment in the State of Washington "shall be reasonably in accordance with accepted lighting methods and the findings and recommendations of the Society of Automotive Engineers and the Illuminating Engineering Society" according to a law which took effect April 1.

Couched in general terms requiring "such distribution of light that it will reveal persons, vehicles and objects within a reasonable distance ahead . . .", the law provides that specific rules and regulations shall be made by a state commission on equipment. "This places the State of Washington in a unique position as being able always to have up-to-date regulations for automotive lighting specifications," writes Chairman D. B. Rigg of the Commission on Equipment in a letter to the SAE asking for the latest specifications developed by the Society and the IES "so that we may adopt these specifications as rules and regulations for the Commission on Equipment."

Hear Papers on Hypoid Gears; Aircraft Parts

● Kansas City

The Kansas City Section's March 19 meeting included both a business and technical session. During the business portion of the program a nominating committee was elected and C. A. Shepard, chairman of the membership committee, gave a brief talk on the benefits of the SAE and invited all non-members present to make application for membership.

Chairman E. W. Pughe then introduced Claude Johnson, secretary and treasurer, Jesco Lubricants Co., who spoke on "Hypoid Gears in Service," and Allen Smith, project engineer, Stearman Aircraft Co., whose subject was "Modernizing Moving Parts in Aircraft." Mr. Smith's paper was illustrated with slides.

Among those taking a prominent part in the discussion were Ralph R. Matthews, Battenfeld Grease & Oil Corp.; C. W. McAllister, Sinclair Refining Co.; and W. W. Brown, W. W. Brown Machine Works.

Cars Visioned 100 lb. Lighter–Better–Cheaper

"It is not beyond the realms of possibility to imagine each production automobile to be 100 lb. lighter, using the same materials, without in any way deteriorating it functionally—perhaps improving it," SAE President Harry T. Woolson, executive engineer, Chrysler Corp., told the American Society for Testing Materials in Detroit last month.

"Think of this as applied to a 5,000,000-car year in terms of economies in manufacture, as well as subsequent operating economies during the life of the product," he said. "It is toward such possibilities that future material development should lead the various fields of engineering."

Saying that weight reduction strongly intrigues the engineering mind, Mr. Woolson continued: "An automotive fundamental is the attainment of desired strength and rigidity with minimum weight. This naturally is tempered with a wholesome regard for the commercial considerations of cost. Automotive engineers consider the presence of 'lazy pounds,' lowly stressed, as a sign of poor engineering.

"The younger generation," Mr. Woolson concluded, "should be happy in the thought that *so much* has been left for them to accomplish in all lines of engineering. They should be encouraged by the fact 'that nothing is done finally and right; that nothing is known positively and completely.' "

72% of Cars Fail 1st Portland Inspection

● Oregon

Portland, Oregon, began compulsory inspection work on Jan. 1, 1937. Approximately 50,000 cars were run through its new motor-vehicle inspection station during January, February and March. Of this number, only 14,000 passed the first time.

These were outstanding among the facts developed by Paul Anderson, chief inspector of the station, when he talked to the Oregon Section on April 9, substituting for SAE member J. Verne Savage, the station's superintendent who had been called out of town.

The meeting was held "on location" at the inspection station and was open only to members and specially invited guests who witnessed an actual demonstration of the inspection routine. A new car was taken through one of the station's five lanes. After an inspector had checked horn, windshield wiper, stop light and rear-view mirror, the car was run over a wheel alignment machine and a brake tester. Finally lights were checked by headlight testing equipment.

Results of each test were marked on a regulation inspection car. The car, although practically new, was rejected because of unequal braking pressure on the rear wheels.

Defective lights are responsible for more rejections than any other single item thus far, Mr. Anderson told his listeners, 52 per cent of all rejections having been for this cause. Bad brakes have accounted for 25 per cent of Portland inspection station rejections, he said, poor wheel alignment for 10 per cent. A host of miscellaneous troubles make up the remaining 13 per cent. During the month of March, 22,000 cars were inspected, Mr. Anderson stated, but only 5260 (about 24 per cent) passed the first time.

A car which is rejected is given a week to be repaired and brought back for re-inspection. This procedure is repeated as many times as necessary. A 50-cent fee is collected when the car finally passes. Every car in Portland must pass this test twice each year. The public, ac-

cording to Mr. Anderson, is very cooperative for the most part and is appreciative of the work being done by the inspection station.

"Engineers Day" will be held on the campus of Oregon State College on May 15, Prof. William Paul announces. Student prizes offered by the Oregon SAE Section will be awarded at that time, when a joint meeting of the Oregon Section and the American Society of Mechanical Engineers and the American Society of Metals is scheduled.

Student contest papers will be presented at a meeting of the Oregon Section in Portland on May 14.

Superchargers Topic Of SAE Club Meeting

• Denver

Keeping up to date on supercharger developments, the SAE Club of Denver at its March 26 meeting heard its secretary, Joseph P. Ruth, give a short talk on the subject, which he augmented with excerpts from recent papers appearing in SAE TRANSACTIONS. A supercharged Graham and also a Ford with a special supercharger attachment were on display.

More than 75 members and their guests attended the meeting. Eugene L. Wagner was host.

New Process Seeks Ideal Crankshaft

• Cleveland

"We can now approach the ideal crankshaft, one with maximum ductility to withstand physical abuse and with high bearing hardness to withstand wear and abrasion," said W. E. Benninghoff, Tocco Division, Ohio Crankshaft Co., in a paper read before the Cleveland Section's April 12 meeting.

This process is an application of high frequency induction heating to the work which it is desired to harden, and represents a most ingenious method of applying a hardened surface to any type of shaft.

In attempting to obtain a hardened wearing surface on crankshafts, Mr. Benninghoff said, carburizing, nitriding, and many other methods have been tried. However, they have all had some defect. They were slow, expensive, difficult to control, and often erratic in their results. Also, there was often a high degree of distortion present. In the "Tocco" process, a high frequency current of 2000 cycles is passed through an inductor block surrounding the bearing to be hardened. This high frequency current produces eddy currents and hysteresis losses in the bearing surface, and causes heat to be generated in the surface of the steel itself. The inductor blocks remain cold. Due to the inherent reaction of the steel as its temperature rises, the heating effect decreases as the critical point is approached; consequently, continued application of power only causes the heat to be generated farther in toward the center of the shaft.

With the application of high frequency current to the inductor block, the bearing surface is heated to the quenching temperature for a depth of approximately ⅛ in. in approximately 5 sec., and is then immediately quenched by pressure spraying through orifices drilled through the inductor blocks, and into a water jacket which is integral with the block.

The structure, the speaker stated, is extremely fine grained martinsite in the hardened area, and even at 1000X the usual large needles associated with martinsite are absent. This results in exceptional ductility throughout the hardened area. Also, due to the rapidity of the heating cycle, surface decarburization and grain growth do not occur. After hardening and drawing at a low temperature, the surface is finish ground. A hardness in the order of 58-62 Rockwell "C", which is approximately 85 Brinell, is obtained, and this is maintained through about 80 per cent of the depth of the hardened area. Material used is usually a modified SAE 1045 or 1050 steel.

The combination of accurate control, split second heating cycles, and pressure quenching applied instantly at the end of the heating cycle produces a cohesion between the hardened area and the core which blends gradually into the core structure without any marked precipitation of free ferrite either in or below the gradation zone. This condition prevents flaking or spalling in service, of the hardened area.

This paper created a most interesting discussion which was augmented particularly by Otto M. Burkhardt, who acted as sponsor for the meeting. Its success was further assured by the fact that the host for the "Social Half Hour" preceding the meeting was the Spicer Manufacturing Corp., which through its representative, Robert V. Hessler, afforded a most genial time for all.

Winners of the Cleveland Section Student Essay Contest this year are: First prize, John Burke, a sophomore at Case School of Applied Science, for his paper, "Rear Engine Passenger Cars"; second prize, H. R. Blasingham, a senior at Case for his paper, "The Diesel Engine"; and third prize, M. A. Wood of the General Motors Institute, Winton Branch, for his paper, "Anodizing—Its Characteristics and Properties."

The next Cleveland Section meeting will be the Spring Outing. It will be held in early June at the Lake Forest Country Club.

S. S. Melin is the designer of a clever and effective electric "silent salesman" board showing advantages of SAE membership. It was first displayed at the Cleveland Section meeting in March. Mr. Melin has been an active worker under Section membership committee chairman, J. D. Ceader.

Roos-Taub Represent SAE At International Meeting

Past-President D. G. Roos, Studebaker Corp., and Council Member Alex Taub were the Society's representatives at the International Congress of the International Association for Testing Materials which was held in London, England, April 19-24.

More than 200 papers were presented under the following group heads: metals, inorganic materials, organic materials, and subjects of general importance. Authorities from about 20 different countries participated.

Austin Wolf Discusses Automatic Transmissions

• Milwaukee

"Transmissions for Automotive Vehicles," was the timely subject discussed by Austin M. Wolf, automotive consultant, before the Milwaukee Section at its April 2 meeting. The author gave a clear and concise summary of the developments taking place in the adoption of automatic or semi-automatic transmissions to replace the present type. He used slides to picture mechanical, hydraulic, electrical and combination types of transmissions now available, and discussed each.

Oscar H. Banker, designer of the Banker Automatic Transmission, now used in certain metropolitan buses, took a prominent part in the discussion following Mr. Wolf's paper.

Students Have Display In Engineering Exhibit

• U. of Alabama

The Baron Shiba moving pictures showing the flow of air about airfoils and other interesting studies of high-speed photography were presented before the University of Alabama Student Branch at its February meeting. Professor Lunde of the University's aeronautical department explained the films and described the method of taking them.

In March the Branch participated in an engineering exhibit at the University. Their display included a cut-a-way engine driven by a small electric motor, a set of reduction gears, a transmission, a steering mechanism and a midget automobile; all products of the University's machine shop.

About Authors

(Continued from page 11)

years with a manufacturer of electrical machinery he had his first contact with the automotive industry when he joined the Munson Co., of Laporte, Ind., which was developing a combination gasoline-electric automobile. He then went with Western Electric for a few years before going to Europe, visiting Germany, Belgium and France, as well as covering the Paris World's Fair of 1900 as editorial representative for "Electrical World" and "Horseless Age." Returning to the United States he joined the editorial staff of "Horseless Age" (now "Automotive Industries") for which publication he still writes as engineering editor. Mr. Heldt is author of numerous widely used automotive engineering text books, many of which have been translated into several languages. He joined the SAE in 1908.

• L. C. McCarty, Jr., ***has been project engineer on large flying boats for the Glenn L. Martin Co. since 1932, and was responsible, in this capacity, for the "China Clipper" and her two sister ships. He took part in some of the "China Clipper's" pioneering flights across the Pacific. Before joining Martin he was vice-president in charge of engineering and manufacturing with the Miami Aircraft Corp., builders of five-passenger flying boats. A transport pilot licensed on the largest flying boats, he was captain during the factory trials of the second Martin trans-Pacific Clipper. He was educated at Yale and received his first flying training with the Air Corps Reserves in 1924.***

• J. Carlton Ward, Jr., ***was works manager for the Pratt & Whitney division of the Niles-Bement-Pond Co., back in 1925 when the first Pratt & Whitney aircraft engine was built. He left to become vice-president of the Hartford Machine Screw Co., and while there developed a division to make small precision airplane-engine parts. This was followed by five years with the General Cable Corp., in charge of all manufacturing. He returned to Hartford in 1935 as assistant to D. L. Brown, president of United Aircraft Corp., and later was made assistant general manager of Pratt & Whitney Aircraft, division of United Aircraft. He is an alumnus of Cornell.***

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Mar. 10, 1937, and Apr. 10, 1937.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

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BEAVER, KARL (J) research engineer, Ethyl Gasoline Corp., Engrg. Lab., 723 East Milwaukee Ave., Detroit, Mich.

BELL, STANLEY (F M) Aeronautical Corp. of Great Britain, Ltd., Walton Works, Peterborough, England.

CARLSON, WILLIAM H. (A) sales representative, Twin Coach Co., 2519 Graybar Bldg., 420 Lexington Ave., New York City.

CLARKSON, RALPH R. (A) Detroit representative, Latex Fiber Industries, Inc., Beaver Falls, N. Y.; (mail) 6600 East Jefferson Ave., Detroit, Mich.

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HILLING, JAMES H. (A) supervisor, truck transportation, General Electric Co., Incandescent Lamp Dept., Nela Park, Cleveland, Ohio.

HOLT, GLEN GROVER (A) vice-president, charge of sales, Perfex Radiator Co., 415 West Oklahoma Place, Milwaukee, Wis.; (mail) 5261 North Hollywood Ave.

HORI, YASUO (M) engineer, testing aeronautical engines, Mitsubishi Jukogyo Kaisha, Ltd., Ohemachi, Minami-ku, Nagoya City, Japan; (mail) Mitsubishi Shoji Kaisha, Ltd., 120 Broadway, New York City.

JORDAN, ALBERT P. (A) service manager, Autocar Sales & Service Co., 226 Whalley Ave., New Haven, Conn.

KERR, A. B. (M) publisher, Motor Truck & Equipment, 30 Duncan St., Toronto, Ontario, Canada.

LAMPERT, ALBERT (F M) special engineer, technical representative, Societe Anonyme Ad. Saurer, Arbon, Switzerland.

LEMAY, JOSEPH ARTHUR (A) comptroller of equipment and road signals, Quebec Provincial Government, Department of Roads, Parliament Bldgs., Quebec City, Quebec, Canada.

LUNDE, RALPH N. (A) assistant professor, agricultural engineering, Oregon State College, Corvallis, Ore.; (mail) 141 North 27th St.

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MCCOY, JOHN T. (M) general supervisor, research and development department, Tide Water Associated Oil Co., East 22nd St., Bayonne, N. J.

MCKINLEY, HERMAN T. (A) service supervisor, General Motors Truck & Coach, Inc., 103 North Beacon St., Boston, Mass.; (mail) 70 Chaffee Ave., Waltham, Mass.

MCNERNEY, JOSEPH F. (A) service manager, Boro-Motors-Pontiac Dealer, 815 East New York Ave., Brooklyn, N. Y.; (mail) 114-20 – 131st St., South Ozone Park, L. I., N. Y.

NOON, JOSEPH E. (A) service manager and purchasing, Commonwealth Chevrolet Co., 1065 Commonwealth Ave., Boston, Mass.

NORRIE, ROBERT CHAS. (J) draftsman, Kenworth Motor Truck Corp., Seattle, Wash.; (mail) 5107 Phinney Ave.

PORTER, HAROLD R. (J) junior engineer, Standard Oil Co. of Calif., Richmond, Calif.; (mail) 211 Yale Ave., Berkeley, Calif.

RAY, JOHN CLIFFORD (M) assistant superintendent, maintenance, Eastern Air Lines, 36th St. Airport, Miami, Fla.; (mail) 915 Ferdinand St., Coral Gables, Fla.

RAYNOR, ALLEN GEORGE (A) service superintendent, Sterrett Operating Service, Inc., 600 South Caroline St., Baltimore, Md.

RICARDO, ERIC ALEXANDER (A) Thomas Cook & Sons, Ltd., Hornby Road, Bombay, India.

ROENSCH, MAX MOSS (M) experimental engineer, Chrysler Corp., Detroit, Mich.; (mail) 1205 Eaton Road, Birmingham, Mich.

RONAN, JOHN T. (J) research engineer, Shell Oil Co., Martinez, Calif.; (mail) 1935 Pacheco Blvd.

ROTH, ADAM GEORGE (M) design and production engineer, Air Associates, Inc., Garden City, L. I., N. Y.

ROTH, WILLIAM HARRISON (M) service representative, General Motors Sales Corp., Oldsmobile Div., Philadelphia, Pa.; (mail) 236 Wabash Ave., Lansdowne, Pa.

SCHOOLEY, RALPH E. (J) mechanical engineer, American LaFrance & Foamite Corp., 300 Spaulding St., Elmira, N. Y.

SHORTER, LEO JOSEPH (F M) chief engineer, Singer Motors, Ltd., Canterbury St., Coventry, England; (mail) 9 West Ave., Stoke Park.

SMITH, CARSON W. (A) president, Consolidated Coal & Coke Co., 421 Empire Bldg., Denver, Colo.

SMOOTS, JOHN P. (M) development engineer, Standard Oil Co., Midland Bldg., Cleveland, Ohio.

SNYDER, RAYMOND R. (M) chief experimental and development engineer, Pierce-Arrow Motor Corp., 1695 Elmwood Ave., Buffalo, N. Y.

TEMPEST, CLIFFORD MORLEY (A) technical advisor and service manager, Westcott, Hazells Service Center, "The Arches," York St. North, Sydney, Australia.

TWINING, FREDERICK WOLVERTON (A) manager, technician, charge of motor laboratory, Twining Laboratories, P. O. Box 1320, Fresno, Calif.

VAN HORN, E. C. (A) supervisor, Motor Vehicle Testing Station, 625 Boren Ave., North, Seattle, Wash.

VOKES, CECIL GORDON (M) managing director, Vokes, Ltd., 95-105 Lower Richmond Road, Putney, S. W. 15, London, England.

WESTEFELDT, GEORGE (M) Hudson Motor Car Co., 12601 East Jefferson Ave., Detroit, Mich.

WHITEHEAD, DONALD E. (A) traveling representative, Lubri-Zol Corp., Box 3057, Euclid Station, Cleveland, Ohio; (mail) 1755 Chapman Ave., East Cleveland, Ohio.

WHITING, JUSTIN R. (A) time study engineer, DeVilbiss Mfg. Co., Toledo, Ohio; (mail) 1416 Shenandoah Road.

YERZLEY, FELIX L. (J) physicist, E. I. Du Pont De Nemours & Co., Wilmington, Del.; (mail) Box 525.

Applications Received

The applications for membership received between Mar. 15, 1937, and Apr. 15, 1937, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

BALMER, RICHARD C., draftsman, Yellow Truck & Coach Mfg. Co., Pontiac, Mich.

BLANK, H. E., JR., assistant editor, Chilton Co., Philadelphia, Pa.

BORGER, JOHN GODFREY, JR., engineer, Pan American Airways Co., Alameda, Calif.

BOURQUE, A. V., secretary-treasurer, Western Petroleum Refiners Assn., Tulsa, Okla.

BRANSTETTER, OVID MILTON, Diesel Fuel Representative, Socony-Vacuum Oil Co., Detroit, Mich.

BRUCE, JAMES G., technical editor, The MacLean Publishing Co., Ltd., Toronto, Ont., Canada.

BURNS, WALTER E., president, W. E. Burns, – Dan Burns, Portland, Oregon.

BURGIE, F. W., chief engineer, Doehler Die Casting Co., Toledo, O.

BYERS, ROBERT DAVID, air engineer, London Flying Club, London, Ont., Canada.

COPELAND, FLOYD B., Detroit representative, Doehler Die Casting Co., Toledo, O.

CORNWELL, BURR IRWIN, garage superintendent, Hall Baking Co., Somerville, Mass.

COURTNEY, JOSEPH F., president, Underwriters Safety Device Corp., Chicago, Ill.

CRANE, WALTER JACKSON, Portland Gas & Coke Co., Seattle, Wash.

CUMMINGS, EMERSON LEROY, Captain, Ordnance Department, U. S. Army, Washington, D. C.

DAVIS, BERNARD, 6 Franklin Gardens, Roxbury, Mass.

DAVIS, ROY H., president, Canadian Atlas Steels Ltd., Welland, Ont., Canada.

DUNCAN, TURNER A., special assignment engineer, General Motors Truck & Coach Co., Detroit, Mich.

ERICKSON, R. O., manager, lubricating and industrial department, Shell Petroleum Corp., Detroit, Mich.

FALLON, FRANCIS X., Diesel electrical appren-

(Continued on following page)

tice, New York, New Haven & Hartford R. R. Co., Boston, Mass.
FERRIE, JAMES ANDREW, wholesale salesman, Shell Oil Co., Los Angeles, Calif.
FOLTZ, WARREN D., representative, Bendix Westinghouse Automotive Air Brake Co., Pittsburgh, Pa.
FORTNEY, WALTER S., power prover supervisor, Cities Service Co., Fort Worth, Texas.
FRIEND, P. E., chief engineer, Wilkening Mfg. Co., Philadelphia, Pa.
HALLER, FREDERICK E., treasurer, Mt. Lebanon Garage Co., Mt. Lebanon, Pa.
HARRIS, WILLIAM H., JR., engineer, Micromatic Hone Corp., Detroit, Mich.
HELLING, CHARLES HAROLD, automotive stock clerk, E. A. Wildermuth, Brooklyn, N. Y.
HEM, LAWRENCE WILLIAM, tutor, mechanical engineering, School of Technology, College of the City of New York, New York City.
HOENER, S. T., research and foreman, International Harvester Co., Chicago, Ill.
HOLLOS, DIPL. ING. ZSIGMOND, designer, Vienna, Austria.
HUNT, DAVID ELDRIDGE, 66 Chickatabot Road, Quincy, Mass.
JOHNSON, RUSSELL HAROLD, engine design, Yellow Truck & Coach Mfg. Co., Pontiac, Mich.
KANE, L. H., garage superintendent, Willett Co., Chicago, Ill.
KELLER, GEORGE C., sales engineer, Cities Service Oil Co., New York City.
KELLER, GEORGE H., research assistant, The Pennsylvania State College, State College, Pa.
KIDD, ROBERT STORMONT, draftsman, Ranger Engineering Corp., Farmingdale, L. I., N. Y.
KROPF, EMIL AUGUST ADAM, Dipl. Ing., Aviation manager, Deutsch-Amerikanische Petroleum Gesellschaft, Hamburg, Germany.
KUHNE, PAUL K., supervisor, Gulf Oil Corp., Philadelphia, Pa.
LANAGAN, W. P., president, Lanagan & Hoke, Inc., Philadelphia, Pa.
LEATHERS, L. A., 240 Madison Ave., Brookville, Pa.
LOVELL, WHEELER G., assistant head, fuel department, Research Laboratories, General Motors Corp., Detroit, Mich.
LUXMOORE, EMERSON JOHN, assistant project engineer, on passenger car bodies, Chevrolet Motor Co., Detroit, Mich.
MACKECHNIE, THOMAS HUGH, motor vehicle superintendent, Southern California Telephone Co., Los Angeles, Calif.
MARETTE, RALPH THOMAS, in charge mechanical testing, Cleveland Industrial Research, Inc., Cleveland, O.
MCBRIEN, R. L., engineer, United Air Lines Transport Corp., Chicago, Ill.
MCDONALD, JOHN B., service manager, The White Motor Co., Chicago, Ill.
MCLEOD, MILTON KENNETH, assistant, Massachusetts Institute of Technology, Cambridge, Mass.
NAERY, JOHN S., assistant to president, Donaldson Co., Inc., St. Paul, Minn.
OSTERMAN, FRED, president, Nelson Chevrolet Co., Chicago, Ill.
POWERS, EDWARD F., technical supervisor, National Carbon Co., Inc., New York City.
RANDOLPH, JOHN W., agricultural engineer, Bureau of Agricultural Engineering, USDA, Auburn, Alabama.
SINGER, FRANK N., superintendent of transportation, Adolf Gobel, Inc., Brooklyn, N. Y.
SKOWBO, ELMER, salesman, The Dole Valve Co., Chicago, Ill.
SOCIETA ITALO AMERICANA PEL PETROLIO, Raffineria di Trieste S. Sabbo, Italy.
STEIN, LOUIS H., factory superintendent, Aetna Ball Bearing Mfg. Co., Chicago, Ill.
SZYMANOWITZ, RAYMOND, technical director, Acheson Colloids Corp., New York City.
THOMSON, WALLACE GEORGE, salesman, Sarvas Electrical Co., Brooklyn, N. Y.
WERDER, JOHN FREDERICK, vice-president and chief engineer, The Zip Abrasive Co., Cleveland, O.
WHEILDON, WILLIAM MAXWELL, JR., Framingham, Mass.
WILES, HOWARD M., research engineer, Waukesha Motor Co., Waukesha, Wis.
WIRICK, CAREY G., national sales, Diamond T Motor Car Co., Chicago, Ill.
WOLFSON, MILTON A., sales manager, Maremont Automotive Products, Inc., Chicago, Ill.

SAE *Coming* EVENTS

Baltimore—May 13
Longfellow Hotel; dinner 6:30 P.M. Brakes – S. Johnson, Jr., chief engineer, Bendix-Westinghouse Automotive Air Brake Co.

Buffalo—No Meeting

Canadian—May 14
Regional Meeting Genosha Hotel, Oshawa; dinner 7:00 P.M. Speakers – Harry J. Carmichael, vice-president and general manager, General Motors of Canada, Ltd., and Maurice Olley, engineer, special problems, General Motors Corp.

Chicago—April 30
Hangar of the 108th Observation Squadron, 33rd Division, 6048 S. Cicero Ave., Chicago, Ill.; dinner 6:30 P.M. Newest Developments in Aeronautics – William Littlewood, vice-president of engineering, American Airlines, and Major Chester L. Fordney, Commanding Officer, Central Reserve Area, U. S. Marines. There will also be an inspection trip of the Chicago Municipal Airport, the American Airlines, and the military aviation exhibit.

Cleveland—No Meeting

Dayton—May 20
The Dayton Section will be the guests of the Indiana Section at its Annual 500-Mile Race Meet and dinner, at the Athenaeum, Indianapolis, Ind.

Detroit—May 25
Hotel Statler; dinner 6:30 P.M. Scraps from an Economy Scrapbook – W. S. James, chief engineer, and S. W. Sparrow, research engineer, of the Studebaker Corp. This will be a closed meeting, for members only.

Kansas City—No Meeting

Summer Meeting
May 4-9
The Greenbrier
White Sulphur Springs, W. Va.

Fuels and Lubricants Regional Meeting
Sept. 30 & Oct. 1
Tulsa, Okla.

National Aircraft Production Meeting
Oct. 7-9
Ambassador Hotel
Los Angeles, Calif.

Annual Dinner
Oct. 28
Commodore Hotel
New York

National Production Meeting
Dec. 8-10
Flint, Mich.

Milwaukee—May 7
Wisconsin Club; dinner 6:30 P.M. Ladies' Night, at which the film "Flying the Lindbergh Trail" will be shown.

New England—May 11 *
Walker Memorial, M. I. T., Cambridge, Mass.; dinner 6:30 P.M. C. M. Belinn, superintendent of engineering, National Airways, Inc., will be the speaker of the evening.

No. California—May 11
Hotel Bellvue, San Francisco; dinner 6:30 P.M. Subject – Parts cleaners, valves, etc.

Northwest—May 28
Fort Lawton, Seattle, Wash. Field day – new car demonstration – safe driving contest, with all current models available.

Oregon—May 14
Imperial Hotel, Portland; dinner 6:30 P.M. Review of all papers entered in the Student Award Contest.

Philadelphia—May 12
Engineers Club; dinner 6:30 P.M. Ten Years' Progress in Airplane Powerplants – R. W. Young, technical director, Foreign License Division, Wright Aeronautical Corp.

Pittsburgh—May 25
Webster Hall Hotel; dinner 6:30 P.M. Preventive Maintenance – O. M. Brede, director of service, General Motors Truck & Coach Division, Yellow Truck & Coach Mfg. Co.

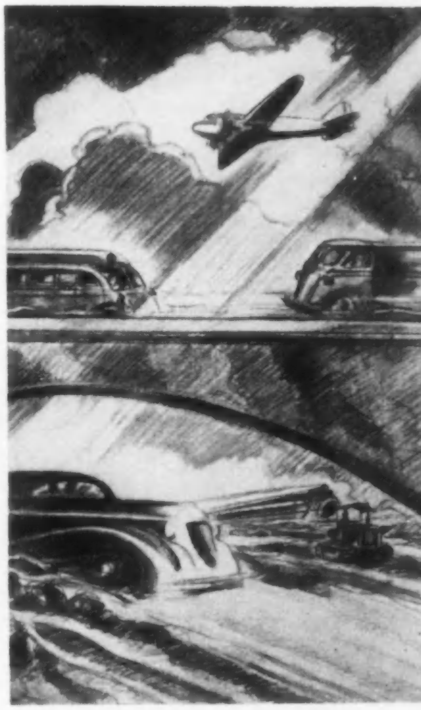
So. California—May 22
Jonathan Club, Los Angeles; dinner 6:30 P.M.

St. Louis—May 13
Jefferson Hotel; dinner 6:30 P.M.

Washington—No Meeting

What

Foreign Technical Writers Are Saying



EVERY month the SAE Research Department will cover every important foreign automotive technical publication and prepare these brief, crisp summaries of all articles which have something new or vital to give to automotive engineers outside the country in which they were published.

Scanning of these columns each month will keep you up to date on everything of automotive engineering importance published outside the United States. Other pages of the SAE Journal tell you about domestic developments.

AIRCRAFT

Longitudinal Stability

By J. H. Crowe. Published in *Aircraft Engineering*, March, 1937, p. 59. [A-1]

The basic theory of stability has undergone no important modification since the publication of Professor G. H. Bryan's book on *Stability in Aviation* in 1911, and the stability equations derived therein serve today with the difference that axes and symbols have now been standardized and with the additional refinement of a non-dimensional form of the stability equation introduced by H. Glauert. Due to the vastly increased knowledge of aerodynamic characteristics, however, the stability derivatives are more readily assessable in any particular design case, the author points out. The method proposed by the author for dealing with different plan forms is expected to show the effects of differently tapered high and low wing monoplanes, indicating which terms are of first importance and which can be neglected.

Aerodynamic and Structural Features of Tapered Wings

By G. V. Lachmann. Published in *The Journal of The Royal Aeronautical Society*, March, 1937, p. 162. [A-1]

Dr. Lachmann, while acknowledging that research on this subject is still incomplete, points out that since there are still quite a variety of views held by various designers on certain subjects connected with tapered wings, his paper presenting the design policy which he has followed may challenge other views and result in productive discussion.

Probleme des Hubschraubers

By H. G. Küssner. Published in *Luftfahrt-Forschung*, Jan. 20, 1937, p. 1. [A-1]

To bring about further improvement and development in such aircraft as the autogiro, the author contends, problems peculiar to helicopter design and operation should be as intensively studied theoretically and experimentally as have been those of the kite type of aircraft. His contribution is the present theoretical discussion of the lift, flight characteristics, stability and driving gear of helicopters.

His conclusion is that the screw propeller, as used on helicopters, can develop meritorious performance characteristics, which, although difficult to determine theoretically, are demonstrated in practice.

Le Groupe Motopropulseur Moderne

By Michel Précoul. Published in *Revue du Ministère de l'Air*, December, 1936, p. 1517. [A-1]

The present state of supercharger development makes possible the maintenance of inlet manifold pressures satisfactory for stratospheric flight, at altitudes of from 45,000 to 55,000 ft., according to the theoretic analysis here presented. The use of directly-driven centrifugal compressors, with three or four gear ratios, is suggested as the solution for the immediate present. A second advantage urged for superchargers which can be thrown out of gear is that they permit take-off at full power.

However, the turbo-compressors, although more delicate, should not be discarded without further investigation. If the performance predicted by Rateau can be attained, the turbo-compressor would offer an extremely satisfactory solution of the problem. The Roots-type supercharger appears from this analysis to be less apt to be used in the near future, especially for high-power engines.

Even if superchargers have been so far developed as to enable them to maintain pressure in the inlet manifold, other problems must be solved before high-altitude flying can be successfully achieved. Among those mentioned are cooling, lubrication, ignition, variable-pitch propellers, and the securing of engine air supply.

The addition of combustion accelerators, such as amyl or ethyl nitrate, to aviation Diesel fuels is an expedient adopted recently to facilitate smooth combustion and avoid ignition lag. Recent trends noted in Diesel aircraft engines are decrease in weight through the use of special steels and light alloys, the use of supercharging, the increasing popularity of the in-line water-cooled type and the two-stroke cycle, and increasing power output. Of the 20 aircraft Diesels whose design and performance characteristics are tabulated, the Junkers is thought to have reached the highest state of development.

This article, treating of supercharging and Diesel engines for aircraft, is intended to supplement previous papers and to complete a review of modern aircraft powerplants.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

Untersuchung eines Windkanals

By S. Hoerner. Published in *Luftfahrt-Forschung*, Jan. 20, 1937, p. 36. [A-1]

During the installation of the wind tunnel in the aerodynamic laboratory of the engineering college at Braunschweig, a number of investigations were carried out and design changes made, and these are here reported. The power requirement was determined, and a means of reducing it installed. Investigations with the adjustable deflectors showed that the deflector angle affected the velocity distribution in the return duct and in the jet, but that its influence on the power requirement was small. The character of velocity distribution is reported and turbulence is said to be slight as compared with other tunnels.

The effect on the air jet of its passage through the free space is described. The loss in air force during this time is said to be about 10 per cent, and to constitute 17 per cent of the tunnel's total aerodynamic loss. Venting the return

duct is said to have overcome the difficulties of oscillating air currents and back pressure. The effect of variously shaped entrances of the return duct are reported and the type finally selected is described.

Sur l'Appréciation des Qualités Aérodynamiques des Avions

By Michel Précoul. Published in *L'Aéronautique,* December, 1936, L'Aérotechnique section, p. 145. [A-1]

Current pursuit and racing airplanes achieve their high performance through relatively low weight in proportion to engine power; on the other hand, transport planes attain the same goal because of great aerodynamic efficiency. Comparison of drag coefficients also shows the transport plane to be well developed aerodynamically, with pursuit, racing and touring planes following in the order named. With regard to maximum lift the classes of airplane assume the following order: transport, touring, racing. Modern transport airplanes all have comparable aerodynamic characteristics; evidently the widespread adoption of the twin-engine biplane has stabilized progress.

These conclusions are drawn by the author in the course of his article surveying the aerodynamic characteristics of modern aircraft. The first part of the article is taken up by the presentation of a method for calculating the three principal aerodynamic characteristics of an airplane, fineness ratio, lift and drag. Curves and graphs are presented as part of the method, and three coefficients are proposed for the quick evaluation of the three characteristics. Only the specifications easily obtainable for all airplanes are needed as a basis for the calculation.

The method is applied and results given for modern aircraft of all countries, classified in six groups: single-engine touring airplanes of more than 100 hp., single-engine touring airplanes of less than 100 hp., racing, pursuit and transport airplanes, and airplanes which are either large touring or small transport craft.

Trains d'Atterrissage Modernes

By Georges Goldman. Published in *La Technique Aéronautique,* 4th quarter, 1936, p. 306. [A-1]

What influence has increased speed, the goal of current airplane development, had upon landing-gears? The author answers this question by setting forth the demands made on landing gear performance by high speeds and the general design principles that have been applied in meeting these demands, and by describing specific landing gear designs exhibited at the 15th Aircraft Show in Paris. He includes in his discussion shock absorbers, wheels, tires, brakes and methods of operating retractable landing gears.

As a result of his summary, he discerns the following tendencies: widespread adoption of low pressure tires; powerful brakes; light, effective shock absorbers permitting short landing runs and operation on diverse landing surfaces at present high landing speeds; and operation of retractable landing gears by simple, light and reliable mechanisms, with a tendency to use the sources of energy already existing on airplanes.

ENGINES

Schnelle Errechnung der Ventilfederkräfte und Abschätzung des Flatterpunktes – ein Notwendiges Hilfsmittel bei Entwurf und Versuch

By Hans W. Lindemann. Published in *Automobiltechnische Zeitschrift,* Jan. 25, 1937, p. 36. [E-1]

A simplified and quick method for calculating valve acceleration and valve spring forces and determining the flutter point is here outlined.

Dauerhaltbarkeit Geschmiedeter Stahlkurbelwellen und Mittel zur Ihrer Steigerung

By A. Thum and K. Bandow. Published in *Automobiltechnische Zeitschrift,* Jan. 25, 1937, p. 29. [E-1]

The series of tests here reported has for its object the determination of the strength of forged steel crankshafts and methods of increasing it. Typical fractures due to bending and torsional stress are shown, and changes made in the test pieces to increase resistance to such fractures are described.

The tests are said to show, in the first place, that the diameter of the fillet between the crankpin and cheek is of utmost importance in crankshaft durability, and that a definite relation can be shown between this dimension and resistance to torsional and bending stress. However, the transition section between pin and cheek is vulnerable, even with adequate fillet diameter. In steel crankshafts this danger zone can not be avoided by design, but by cold working its resistance to bending stress can be very greatly increased and its resistance to torsional stress can be somewhat improved.

Les Ruptures d'Embiellages sur les Moteurs d'Avion en Ligne à Refroidissement par Eau

By Lieut. Churet. Published in *Revue du Ministère de l'Air,* December, 1936, p. 1567. [E-1]

Half of all the connecting-rod failures occurring in in-line liquid-cooled aircraft engines is due to lack of durability of bearing materials; 29 per cent to the connecting-rods themselves; and 21 per cent to miscellaneous causes. The author bases these conclusions on an investigation of engines retired from service either because of breakage or unsatisfactory operation.

First among the remedies proposed is the development of new bearing alloys having a durability equal to that of other engine parts.

Bearings should further have a thin shell, a firm bond between shell and bearings, a solid mounting of the bearing in the crankcase and oil grooves extending around the circumference of the bearing.

Other suggestions thought of interest in increasing connecting-rod life are to readjust oil-drainage periods, in view of the accelerated aging of oils in modern as compared with older aircraft engines; better ventilation of the engine compartment to reduce the temperature of the engine; and more generous crankcase sections to prevent deformation. As for the connecting-rods themselves, they should be better dimensioned in the interests of increased rigidity, be more highly finished, and subjected to more careful examination for the detection of defects in the metal.

Finally, the author suggests routine replacement of parts following a certain number of hours of operation, with a view to preventing breakdowns in service, and voices the opinion that the increase of power per unit engine weight has been carried to the point where the demands made on engine materials are too great.

MATERIAL

Betriebserfahrungen mit Mineralölen

By Hans. Stäger. Ö.P.I. Report No. 5. Published by Verlag für Fachliteratur Ges., M.B.H., Vienna, Austria. 39 pp.; 20 illustrations. [G-1]

This report covers an investigation, carried out by Austrian Petroleum Institute, of service changes in mineral oils. Under this heading are included changes, due to use, which disturb or interrupt operation. Such changes are conditioned by the nature of the oil and its use, but in every case they are affected most powerfully by two factors, high temperature and oxidation, and these are discussed.

In discussing insulating oil, such as used in electrical equipment, the author advances a number of considerations which are said to correct currently held views. In the field of lubricating oil, an investigation of film formation on metal surfaces is reported. This was carried out by means of an apparatus incorporating a segmented glass bearing. The effect of the bearing metal on the adhesion of the film is shown, and the process of corrosion of lubricated metal parts is examined. The formation of emulsions of oil and water as related to the service condition of the oil was also investigated.

Furnace oil used in high-efficiency boilers is the final subject treated.

Des Carburants et Lubrifiants dans les Moteurs d'Aviation

By M. Ploix. Paper presented at Journées Techniques Internationales de l'Aéronautique, Nov. 23-27, 1936. 50 pp.; 52 illustrations. [G-1]

In dealing with aviation fuels, the author examines their various physical properties, and the relation of these to payload, distribution, vaporization, combustion and its mechanical effects, power and fuel consumption.

Specific gravity is dismissed as of little importance except for aircraft engaged in long-distance flight, where total fuel weight and flying range are of paramount interest. In discussing volatility and vapor lock, the author refers to investigations carried out at Air France on fuel line temperatures, fuel pump design and permissible vapor tension in relation to the 20 per cent point. In connection with vaporization, four types of ice formation are distinguished, and remedies, including carbureter and inlet air heating and alcohol injection, are suggested. The importance of fuel origin and composition with regard to knocking tendency is stressed, and the opinion given that no method now available of measuring the detonation characteristics of fuels gives entire satisfaction. An investigation made by Air France on fuel consumption is summarized and its results presented in the form of a series of curves showing specific fuel consumption as a function of flight altitude and mixture ratio.

Discussion of lubricants is confined to some of the results obtained by Air France in an investigation of cylinder lubrication and the behavior of the lubricant in the neighborhood of the pistons. Concentrating on the tendency of the oil to form deposits, the author states that carbonization is mainly attributable to the engine, while oxidation or polymerization is due to the character of the oil used. Oils are distinguished by their tendencies to form hard or soft deposits, but no laboratory method currently in use is thought to indicate accurately the tendency of an oil to form deposits. Improvement in this characteristic of a lubricant is said to be attainable through the addition of a compounding agent or through further development in oil refining.

Progrès Réalisables dans l'Hydrogénation des Charbons, des Lignites et des Pétroles

By Ch. Berthelot. Published in *Le Génie Civil*, Jan. 16, p. 53 and Jan. 23, 1937, p. 86. [G-5]

About 19 million tons of liquid fuel annually represents the capacity of hydrogenation plants throughout the world. Interest in hydrogenation has been accelerated by the steadily increasing rate of liquid fuel consumption, the decreasing supply of high-quality crude petroleum, and the high quality of the products of hydrogenation, i.e., reduced knocking tendency, and low gum and sulphur content.

One important obstacle in the widespread use of fuels produced by hydrogenation remains to be overcome – high cost. At present, even in the largest and best equipped plants in Great

Britain and Germany, the cost of production, including all industrial charges but excluding taxes, is five times that of gasoline refined from petroleum, delivered at a European port, again excluding taxation.

Research aimed at reducing the cost of production has been actively pushed recently, and a summary of this research carried out in plants in various countries is summarized in this article. The principle subjects of investigation have been the production of hydrogen, the oil blended with the raw materials to facilitate catalytic action, catalyzers, and catalyzing tubes.

MOTOR-TRUCK

Was Bringt die Schau der Nutzfahrzeuge?

By Fritz Wittekind. Published in *Automobiltechnische Zeitschrift*, Feb. 25, 1937, p. 84. [K-1]

A refinement of design and the introduction of new models to round out production programs characterize the motor-truck section of the current Berlin show, rather than any outstanding new developments. Some features mentioned are: the increasing popularity of welded frames, although riveting is still used on the heavy and certain new types; the restriction of the three-axle construction to large motorcoaches and to cross-country vehicles, with even the large capacity motor-trucks using only two axles; the reappearance of the 5-ton truck as part of the trend toward heavier goods vehicles and more powerful engines; engine mounting under the cab or the floor in the interests of greater load space; increasing number of Diesel engines; provisions for burning domestic fuels and air-cooling. Motorcoach development shows the same trends as motor-truck. Descriptions of individual models contained in an article in the March 5 issue of *Automobiltechnische Zeitschrift*, p. 122, supplement this discussion of general design features.

PASSENGER CAR

L'Emploi du Podometre dans l'Appreciation du Confort

By G. Broulhiet. Published in *Journal de la Société des Ingénieurs de l'Automobile*, January, 1937, p. 15. [L-1]

Elaborate instrumentation for the measurement of riding-comfort leads only to baffling complication in the interpretation of results, in the opinion of the author. In the interests of simplification, he ascertains in his riding-comfort research only two types of data, the value of acceleration and the number of accelerations of the same value experienced in operating over a given distance. His instrument consists of an assembly of four pedometers, set respectively for $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ G and G, provided with suction cups so that it may be mounted on any of the window glasses of the car. From preliminary experiments the author determined that the instrument gave reproducible results. He further presents results obtained by the instrument on four different cars operated at the same speed over the same road; on six different locations on the same car operated at the same speed over the same road; on the same car operated with various-sized orifices in its hydraulic shock absorber; and in an investigation to determine the effect on suspension of frictionless springs.

In discussion, M. Keraval expressed the opinion that four is not a sufficient number of pedometers, that an instrument capable of measuring or even classifying accelerations accurately is extremely difficult to construct, and that not acceleration, but rate of change of acceleration is the important factor from the viewpoint of riding comfort. He then described his recording accelerometer, equipped with an integrating device, which gives the complete curve showing the course of accelerations, the exact value of maximum acceleration, and the all-over mean discomfort.

Les Methodes de Mesure de Bruit et Leur Application dans la Construction Automobile

By S. Kagan. Published in *Journal de la Société des Ingénieurs de l'Automobile*, January, 1937, p. 3. [L-1]

At certain speeds, at least, a muffler efficient as a noise reducer may permit higher power than that obtainable with the direct escape of exhaust gas into free air. This is one of the by-products of the study of noise reduction pointed out by the author in his discussion of the exhaust, which he considers the most disturbing source of automotive noise. The result referred to was arrived at by Martin, who, in considering back pressure as an index of power loss, took into account not only the resistance offered to a continuous flow, but also that of an alternating flow. The author describes the sound filter muffler developed by Martin, in which the principles of the acoustical filter are applied to exhaust phenomena. Other mufflers described are those applying the principles of absorption and of reflection.

Other automotive noise sources which the author discusses from the viewpoints of nature of noise and methods of reducing it are carbureter air intake, gears, frame vibration and horns. In connection with the last-mentioned, he refers to systematic measurements now being made in France of automobile-horn efficiency.

Preceding his practical discussion, the author explains the physiological aspects of noise, and instruments for measuring it. Two instruments described in detail are a decibel meter and an acoustical spectrometer developed by the Electro-Acoustical Laboratory, of which the author is the director. The spectrometer is said to provide a very detailed analysis of noise. It is based on the use of a test frequency and superimposes on the noise to be analyzed a pure sound of constant volume but of variable pitch.

S. A. E. Papers in Digest

HERE are digests of papers presented at National and Section Meetings of the Society.

Some of these papers will be printed in full in the S.A.E. JOURNAL.

Mimeographed copies of *all papers received* will be available, until current supplies are exhausted, at a cost of 25 cents per copy to members; and at 50 cents per copy to non-members, plus 2% sales tax on those delivered in New York City. Orders for mimeographed copies must be accompanied by remittance and should be addressed to Sessions Secretary, Society of Automotive Engineers, 29 West 39th St., New York.

National Aeronautic Meeting Washington, D. C.

Fuels and Lubricants Session

Thursday, March 11

The Value of Octane Numbers in Flight – *Dr. D. P. Barnard, Standard Oil Co. of Ind.*

THIS paper represents an attempt to appraise the values of octane-number improvements in aviation gasolines in terms of increased earning power of current-type transport airplanes when proper provisions have been made in the original designs. The procedure consists in computing the change in earning power of a gallon of gasoline when octane-number changes are reflected in altered fuel consumptions or take-off load capacities. In general it appears that:

(1) Depending upon design and operating conditions the revenue earning power of one gallon of gasoline may be increased from 2 to 8 cents per octane-number improvement.

(2) If the octane-number improvement involves a decrease in energy content, the apparent improvement must be discounted by about 2 octane numbers for each per cent reduction in heat content below that of gasoline.

(3) The economic necessity for high-octane number fuels is particularly apparent when long-range operations are involved.

(4) It is evident that the earning power of octane-number improvements is so great that, within practical limits, cost cannot influence the trend toward higher octane numbers to any appreciable extent.

Engine and Laboratory Tests of Stability of Aviation Oils – *Dr. O. C. Bridgeman, National Bureau of Standards.*

PURPOSE of the investigation reported in this paper was to find a suitable laboratory test method for the stability of aircraft-engine oils. Three types of laboratory methods were chosen, and data were obtained on two of them using 22 aviation oils. The two methods were (1) heating the oil with the surface exposed to the air but without aeration, and (2) heating the oil under aerating conditions. Results were compared with engine data on the same 22 oils covering 30 hr. of operation in each case at cruising power with a Pratt & Whitney Hornet engine. Three conclusions are drawn:

(1) Laboratory methods can be developed which will rate the stability of oils in almost any order, depending upon test conditions.

(2) Methods involving aeration of aviation oils are much too severe and do not correlate with engine data.

(3) Heating of aviation oils without aeration at a temperature of approximately 175 deg. cent. appears to be the most significant set of test conditions, and data obtained under these conditions correlate satisfactorily with the service performance of the oils in aviation engines of moderate output.

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SAE Papers in Digest

Continued

Vibration Session

Thursday, March 11

Measurement of Vibration in Flight – *Dr. C. S. Draper and G. P. Bentley, Massachusetts Institute of Technology, and H. H. Willis, Sperry Gyroscope Co., Inc.*

EQUIPMENT for measuring vibration in airplane structures and powerplants during actual flight is described in this paper. This development is the result of a cooperative research program carried out by the Bureau of Aeronautics of the U. S. Navy and the Massachusetts Institute of Technology with contributions of improvements in design and new features by the Sperry Gyroscope Co., Inc.

In its essentials, the M.I.T.-Sperry Apparatus consists of a number of electrical pickup units which operate a central amplifying and recording unit. The recorder is a double-element photographic oscillograph. Each pickup is adapted especially to the type of vibration that it is intended to measure and is made so small that it does not appreciably affect the vibration characteristics of the member to which it is attached rigidly. By using a number of systematically placed pickups, all the necessary vibration information on an airplane can be recorded during a few short flights. The paper takes up in detail flight test installation, sample records and results from flight test, measurement of vibratory strains, pickup units, strain gage, amplifier, oscillograph, and calibrator.

The Vibration Problem in Propeller Designing – *Frank W. Caldwell, Hamilton Standard Propeller Co.*

THIS paper represents an effort on the part of the propeller designer to look at some phases of the vibration problem as it affects him. A very brief description of some of the work being done in vibration is given. The subject is treated from the aspect of experimentation and the physical phenomena without any effort to introduce the mathematical phase of the subject.

Examples are given of the measurements of the vibratory stress in propeller blades by a new method introduced during the last year.

Practical Aerodynamic Problems Session

Friday, March 12

Laminar and Turbulent Boundary Layers as Affecting Practical Aerodynamics – *E. N. Jacobs, National Advisory Committee for Aeronautics.*

THE main part of this paper deals with one of the unsolved problems that impede further progress – the aerodynamics of airfoil sections in relation to further research. In studying laminar and turbulent flow, special consideration is given to determining where the transition from one to the other takes place along the airfoil surface.

With no equipment capable of studying the subject experimentally in the higher full-scale range of Reynolds numbers, the problem has been attacked theoretically by two methods: According to the first method, the laminar boundary layer is supposed to become unstable.

With the second method of attack the mechanism of transition is supposed to be something like separation. This comparison has the advantage that the separation phenomenon is comparatively well understood and can be dealt with quantitively by means of existing theory. Separation and its relation to the transition phenomenon are therefore considered, and the actual behavior of the flow during its change from laminar to turbulent is illustrated.

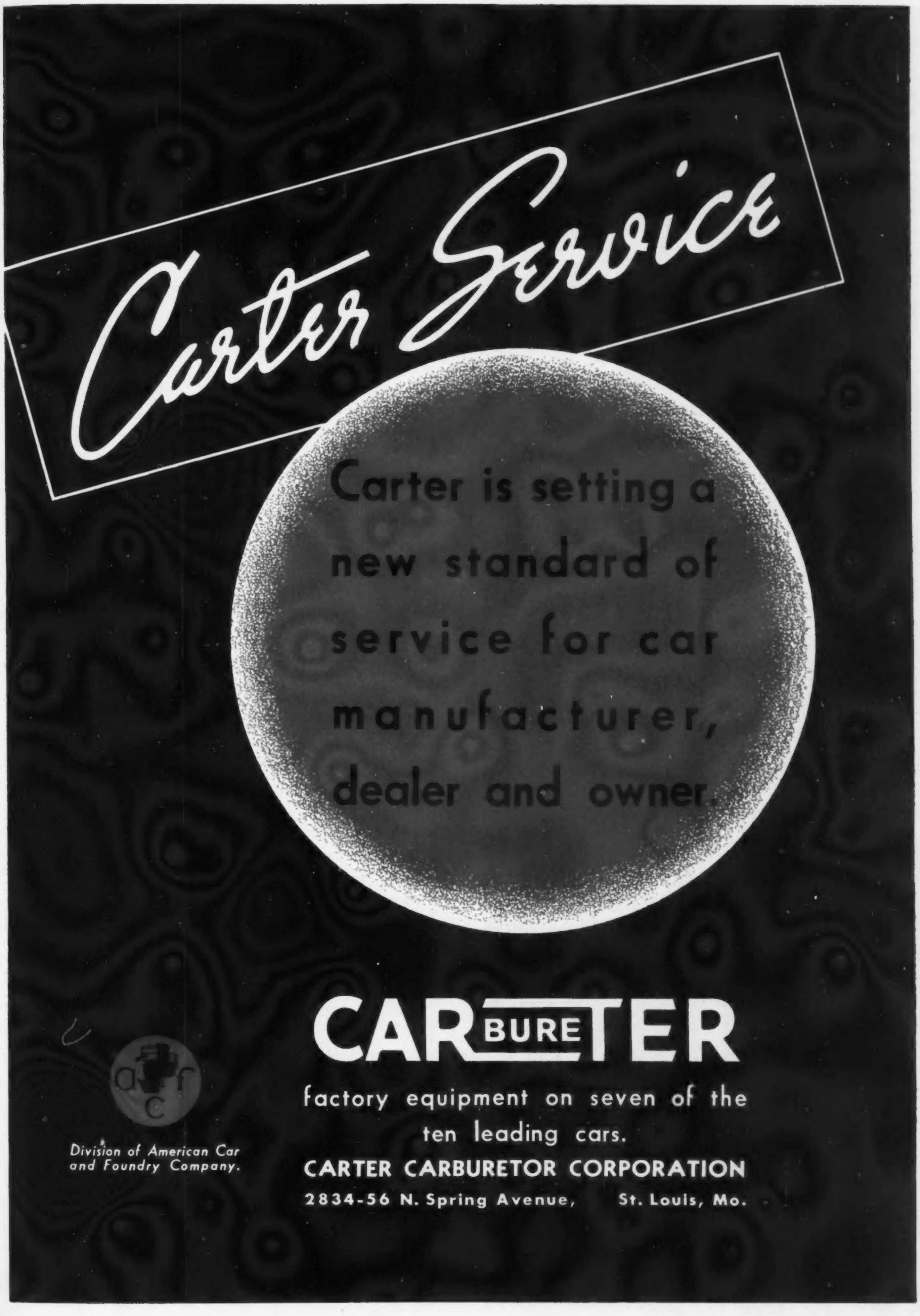
The final conclusion reached, however, is that we do not know but should find out whether theoretical gains indicated are possible. Such investigation will require suitable equipment capable of reaching these very large Reynolds numbers.

The Practical Application of Fowler Flaps – *H. D. Fowler, Glenn L. Martin Co.*

THIS paper takes up the practical design procedure by which to obtain the most efficient characteristics of the Fowler high-lift wing device.

The importance of tail-surface location and the need for greater control power in respect to large airplanes using flaps are considered. The normal and longitudinal forces in Fowlers, and their reduction in a new type of airfoil section and consequent influence on the weight of the complete flap installation, are discussed. How the trend toward high wing loading limits the use of split flaps, and the continuation of the

(*Continued on page 46*)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SAE Papers in Digest

Continued

limit by using Fowlers of 15 per cent to 40 per cent chord, the maximum lift increasing with chord size, are explained.

Advantages of Fowlers in take-off and landing with reference to the possible use of the nose wheel and the effect of the slipstream on the flap are pointed out. Emphasis is placed upon the need for a spare wing (Fowler flap) as an extra safeguard in case of partial engine failure, ice formation, or in emergency landings, referring to several recent crashes caused by these factors.

Longitudinal and lateral controllability is not necessarily reduced by Fowlers, as compared to requirements for the basic airplane.

Engine Sessions

Friday, March 12

Carburetion of Engines for Long-Range Flight – *W. L. Losson, Wright Aeronautical Corp.*

THE permissible payload in long-range flight obviously is dependent upon the fuel load required and, in order to make the fuel load a minimum, accurate regulation of the fuel consumption is necessary. The fuel consumed per hour is determined by the fuel-air mixture and the power output. The latter may be controlled within narrow limits by the automatic propeller and manifold-pressure regulator.

For mixture control in long-range flight, constant-speed propellers with automatic mixture compensation, supplemented by a mixture indicator, are recommended, although semi-automatic compensation, semi-automatic control, and manual mixture control operated in conjunction with a mixture indicator, also may be used.

In the remainder of the paper the characteristics, advantages, and disadvantages of these means of controlling the mixture are discussed.

The Design of Metal Fins for Air-Cooled Engines – *Arnold E. Biermann, National Advisory Committee for Aeronautics.*

THIS paper presents an analysis made to determine the proportions of aluminum and steel fins to dissipate maximum quantities of heat for several pressure differences across a finned cylinder. The power required to force the cooling air between the fins and the relative weights of the various designs are presented.

The calculation of the heat flow in the fins is based on an experimentally verified, theoretical equation, and the surface heat-transfer coefficients and pressure differences were taken from previously reported experiments.

In particular the analysis concerns fins, proportions for minimum pressure drop, minimum power, and minimum weight.

Aircraft-Engine Reduction Gears – *Ford L. Prescott, Materiel Division, U. S. Army Air Corps, Wright Field.*

A BRIEF history of the development of military aircraft engines is presented, bringing out the necessity for the development of reduction gearing. This review is followed by a discussion of seven general types of reduction gears which have proved satisfactory for aircraft engines, each accompanied by a diagrammatic sketch of the gear train. Advantages of, available gear ratios in, and objections to the various types are dealt with in each case.

The matter of stresses in crankcases and engine mounts is then discussed. It is shown that crankcase torque stresses are reduced greatly if the direction of rotation is the same for the crankshaft and the propeller shaft. Advantages of the use of two propellers rotating in opposite directions on the same engine are discussed, with two suggested methods for gearing the propellers.

Advantages of optional propeller rotation on multiengine installations are mentioned. Methods of equalizing tooth loads in multiple-contact types of gearing are discussed briefly, as is the matter of optimum propeller-shaft speed, engine speed, and reduction-gear ratio. The paper is not exhaustive nor technical, but covers briefly the present and immediate future as to desirable types of reduction gearing.

Flexible Exhaust-Valve Seats – *S. D. Heron, Ethyl Gasoline Corp., and A. L. Beall, Wright Aeronautical Corp.*

IN cases where cylinder distortion produces exhaust-valve leakage, the problem of valve burning becomes one of considerable difficulty. A flexible exhaust-valve seat, which apparently conforms to the valve and produces a tight seat even though the cylinder-head be distorted, has

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SAE Papers in Digest

Continued

been designed and tested, as described in this paper. Apparently complete sealing of the valve was secured in a cylinder known to be subject to exhaust-valve-seat distortion. This result indicates that heat dissipation through the seat is not of major importance when a tight seal of the valve is secured. The use of flexible inserts may remove some present limitations on cylinder design.

The Determination of Ratings for Transport Aircraft Engines – *R. F. Gagg, Wright Aeronautical Corp.*

THE objective in determining an engine rating is to establish the limiting values for the variables in operating procedure which permit a maximum of utility in power output and economy of fuel consistent with requirements for safety and durability in the class of service for which the engine is intended. The obvious safety requirement is that no interruptions to service shall occur due to engine trouble when operations are conducted in the manner established by the rating tests.

This paper consists of a discussion of testing methods to be used for the determination of engine ratings, and some suggestions for the adoption of a uniform procedure. Standardization of engine-rating procedure is thoroughly in accord with the established policy of the American aircraft industry as a means of insuring a maximum of safety to air-transport passengers.

American aircraft and engine-testing requirements are more rigorous than those of many of our foreign competitors, and it is for this reason that American products have established a world-wide reputation for safety and durability. If this leadership is to be maintained, technical standardization and advancement must be synchronized and coordinated so that each activity supplements the other.

Lubrication and Cooling Problems of Aircraft Engines – *Weldon Worth, Materiel Division, U. S. Army Air Corps, Wright Field.*

THIS paper presents the problem of engine lubrication from an installation and operation standpoint with respect to starting, warm-up, and stabilized flight. It describes the manner in which these problems are solved by the latest Materiel Division lubrication system, with its oil dilution, hopper-type oil-tank, viscosity-control valve and jacketed oil coolers.

It also analyzes the radiator drag and shows the magnitude of unnecessary radiator drag that may exist if the radiator is not properly designed and installed. The paper then presents a practical design method and shows a sample design calculation for a 1000-hp. engine.

Aircraft-Design Session

Friday, March 12

Interior Finish and Arrangement of Transport Airplanes – *H. O. West, superintendent of engineering, United Air Lines Transport Corp.*

THE trend of transport aircraft design toward larger units is occasioned by increased passenger business resulting from more attractive passenger accommodations, improved performance, and greater safety.

Larger airplanes and stimulated passenger business require that more attention be paid to passenger comfort and crew efficiency and freedom from fatigue. This paper discusses these matters as it concerns present and projected transport aircraft.

Present modern airplanes provide up to 65 lb. of "passenger convenience" in the form of stewardess, comfortable chairs, soundproofing, food, and so on. Recently, sleeper planes have proved successful.

Future land transports will provide much more elaborate passenger comforts. Sleeping accommodations will probably follow general Pullman-type arrangements, but many design problems are presented to the manufacturer. The galley and food service considerations are also important. Separate washrooms will be provided for men and women. Cabin lighting, interior decorating, soundproofing, heating and ventilation all involve much in the way of clever engineering and design.

A crew of at least three undoubtedly will be required for all future transports of larger size than the present craft. Arrangement of cockpit controls and equipment is important to reduce fatigue and improve efficiency. Soundproofing, heating, and ventilation in the cockpit should equal that of the cabin. Cockpit appearance can be improved by proper planning.

Provisions for cargo are secondary. Passenger baggage must be available during flight. Probably plenty of cargo space will be available beneath the cabin floor.

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SAE Papers in Digest

Concluded

Design Tendencies in French Airplane Engines and Propellers – *Henry Lowe Brownback, consulting engineer.*

AT the beginning of aviation the French built air-cooled engines both radial and "in-line" almost exclusively but were forced to swing to water-cooled engines during the War using both V-types and radials. During that period they developed superchargers and the "cannon" engine firing 20-mm. shells through the propeller shaft.

Since the War they have not specialized upon the development of any one type and, in consequence, they have water-cooled V-engines developing 1200 hp., radial air-cooled engines up to 18 cylinders giving 1600 hp., and high-speed "in-line" and V-type engines turning up to 5200 r.p.m. and developing over 1 hp. per cu. in. displacement.

Both water-cooled and air-cooled radial Diesel engines developing 600 hp. have been constructed and flown. Controllable-pitch propellers are being developed in several models and some interesting types are being worked out. It seems that the propeller and not the engine will soon be the limiting factor in powerplant development.

Design Trends as Affecting Ground Facilities – *L. L. Odell, Pan American Airways, Inc.*

THIS paper stresses the extent that airport design, size, and facilities must depend upon aircraft design trends and their size. In this connection the need for the airport designer to know the form and size of future aircraft if he is to provide the permanency expected of him on the ground, is pointed out.

Uncertainty as to future size has resulted in a hangar design that is capable of expansion in two directions. According to the author, three of these expansible hangars will soon be built. The difficulty of obtaining more and more land to provide the necessary area for the constantly increasing length of runways, is emphasized.

The handling of the metal parts, their forming and their maintenance are shown to take up more and more space in the hangar and require more highly trained personnel, as aircraft grow larger and more complex.

At the Dinner

Friday, March 12

European Aviation Engines – *Arthur Nutt, vice president in charge of engineering, Wright Aeronautical Corp.*

A SURVEY of the progress of aviation-engine development in Europe during the last two years is set forth in this paper. The author compares the impressions formed on a recent trip with those made on a similar trip two years before through principal aircraft factories of Germany, Russia, Italy, France, and England.

Expansion of production, personnel, buildings, equipment, and research are investigated for each country, with the political and economic factors that influence development. The lower production efficiency in Europe than in the United States is explained partially by the policy of training men in the factories for further expansion, and the higher percentage of hand operations employed there. A definite trend toward air-cooling is noted.

Development of the sleeve-valve aircraft engine seems to be concentrated in England, whereas most Diesel aircraft-engine development seems to be taking place in Germany, the author observes.

In conclusion, the paper warns that this country must take drastic steps in the near future in order to maintain its position in the aircraft industry both from the military and the commercial standpoints.

Washington Section Paper

April 6, 1936

Transmissions for Heavy-Duty, Commercial, and Mass-Transportation Vehicles – *C. D. Peterson, Spicer Mfg. Corp.*

THE rapid advances in design and the great progress in manufacturing treatment of heavy-duty automotive transmissions for commercial use of the past four years can be attributed mainly to six accomplishments of the transmission engineer and the man in the shop: (1) quieter gear operation, (2) increased transmission life, (3) easier gear-speed changing, (4) reduction in weight-torque ratio, (5) lower operating temperatures, and (6) improved oil sealing.

In general this paper describes how and why these six accomplishments have improved transmissions.

Public Utilities Fleet Meeting

(*Concluded from page 24*)

so using this combination, he explained, they have economy plus adequate power and acceleration. In 5,000,000 miles per year of travel, he remarked, not a single accident has been attributable to throttle stop or governor.

Session Chairman White took issue with the speaker's remark that gasoline is the largest single item of expense, declaring that in his opinion taxes take an important part of the money expended for fleet operation and maintenance.

That the real economy of economy models comes from other factors in their engines and that little is added by throttle stops, is the opinion of Mr. Smith. He remarked that if the throttle is set low enough to effect economy the safety of the car is decreased.

Mr. Bauer told of an operator who found that he could best reduce accidents by using two special instruments on the dash; one a speedometer with a hand recording maximum speed and the other a tachometer with a similar hand. If either of these came in at the end of a run registering above a limit set by the fleet supervisor the driver had considerable explaining to do, Mr. Bauer said.

Practices No-Oil-Change Policy

A test, made several years ago, of running some 20 Ford cars without draining oil, but simply replenishing to keep it at the level recommended by the manufacturer, proved so satisfactory, said Mr. Jahn in his paper on "Results in Non-Changing Motor Oil," that it was decided to adopt a no-oil-change policy for the entire fleet of his company, the Consolidated Gas, Electric Light & Power Co. of Baltimore.

During the very cold winter of 1933, Mr. Jahn recalled that some difficulty was encountered on passenger cars stored in suburban districts. This was brought about by the design of screen and pump and also because the oil used did not have a sufficiently low pour point, he said. To overcome this difficulty and to safeguard against possible troubles from sludge, Mr. Jahn continued, his company is now inspecting crankcases on trucks upon the completion of 10,000 miles and of passenger cars and sedan deliveries at 15,000 miles.

Oil for replenishing between the period of April 15 to May 15, he said, is SAE 20 for passenger cars and SAE 40 for trucks; between Oct. 15 and Nov. 15, oil for replenishing in passenger cars is SAE 20-W and in trucks SAE 30, with a low pour point.

He reported that the total oil consumption for the year following the inauguration of the no-oil-change policy was about half that of the previous year. Maintenance costs have steadily declined from $0.023 per mile in 1930 to $0.01 in 1936, he said, but noted that other factors have contributed to this decrease.

Answering a question as to what oil is used, Mr. Jahn said that his company buys on specifications and doesn't limit its purchases to branded oils. Sludging, he feels, is on the decrease, due in part to full-jacketed cylinder blocks.

Sludging is worth study, said Mr. Fraser, who believes it a matter of ventilation. He has observed that in overhead-valve engines where the dome is tightly sealed, sludge forms more than when there is ventilation. Sludge, he said, can also be brought about by operating conditions, such as taking a bus from a cold garage and putting it into immediate operation. E. C. Guiou, New England Telephone & Telegraph Co., noted that in extreme winter temperatures when vehicles are stored in unheated garages sludging occurs and it is accompanied by sticking valves.

Pooling of Equipment

"Pooling of Passenger Car Equipment" was the subject of Mr. Ray's contribution to the Economy Symposium. He described a spread fleet of 272 vehicles which are pooled so as to encourage joint and economic use of the equipment.

The territory, he explained, is divided into 10 districts and the fleet into 13 pools. All of the passenger cars and most of the trucks are pooled. No cars are reserved and none permanently assigned to individuals, and there is no compensation to cover the use of personally used cars on company business. All passenger equipment is of the same make and type so as to avoid any possibility of discrimination, he added.

Mr. Ray stated that the operation of each pool is handled by a dispatcher who works under the supervisor of automotive equipment. An employe who finds it necessary to use a car, he explained, applies to the dispatcher, who gives him a travel slip that must be completely filled out when the car is returned to the pool. This records all necessary data about the trip. Since the cost of operating the equipment is charged to the department using it, on a mileage basis, Mr. Ray said, it has not been difficult to encourage the practice of riding in groups to a common destination. Likewise, he added, when but one man makes the trip he is encouraged to go by bus or train as the cost to his department is less per mile than for use of a company-owned car.

In setting up such a pool, Mr. Ray advised careful consideration of past use of passenger car equipment, particularly at peak times. In his own fleet cars were assigned on the basis of one for every 1400 miles of demand during the peak months, plus a few extra cars to keep on the safe side. There is now one car in the pool for every 37 miles of distribution, or for every 1577 customers, he said. He found that the change to pool operation made it possible to drop 25 passenger cars from the fleet.

Vehicles, he said, are all equipped with governors; passenger cars being limited to 50 m.p.h., light trucks to 45 m.p.h., and other trucks to 40 m.p.h.

H. C. Nourse, Bell Telephone of Canada, asked a question on the pooling of construction trucks. Mr. Ray explained that it is necessary to study the program of line operation and change trucks from one pool to another to meet these conditions.

Mr. Jahn volunteered the information that in his fleet about 50 employes use their own cars on company business; that they must carry insurance to cover themselves and the company. Their compensation, he said, is on the basis of the cost to operate company-owned cars, about $0.023 per mile, plus $18 a month for fixed expenses. Mr. Jahn also noted that his company hires cars almost every day. When the total averages about ten a week, he said, he makes a requisition for an additional car, as it costs far less to operate a company-owned car than to hire one. It is more difficult, he added, to get the company to purchase a new piece of equipment than to get it to agree to higher operating costs. Mr. Jahn also said that on occasions he also hires trucks. He remarked that hired equipment is almost never in as good condition as that maintained by the company.

S·A·E Summer Meeting

Fires Debate from Home and Abroad

MORE than 600 engineers and guests attended the 1937 SAE Summer Meeting at White Sulphur Springs, West Va., May 4-9.

A greater proportion than ever before actually got on their feet and pitched in to the discussions at the various sessions.

The result was an argument a minute – with masses of fresh information fairly exploded into the meeting rooms.

The fun began early when British and American viewpoints about the future trend of aircraft-engine design clashed at the opening session, the British leaning, for one thing, toward a fewer number of large cylinders, and the Americans, apparently toward a greater number of small ones.

Another aircraft argument revolved around whether or not radio shielding has been overdone due to the manufacturers' desire to "be on the safe side."

Later British and American technicians were at it again – with the combustion system of small automotive Diesels as the bone of contention, an English engineer favoring the separate-swirl chamber and an American builder championing the open-chamber type with a unit injector.

The same British expert told of little-publicized flights across the Atlantic by German Diesel-engined airplanes, and also of continued Diesel success in bus use in England despite parity between gasoline and Diesel fuel prices.

Then it wasn't long before someone was predicting that, with prices of cab-over-engine trucks going down with increasing volume, the time might come when the question would be asked: "Is there a place in transportation for the 'conventional' type of truck?"

Mention of 60 sec. Saybolt as a minimum permissible crankcase oil viscosity, brought a torrent of protest from petroleum men at another session, many of them urging that it is difficult if not impossible to set any given viscosity as a permissible minimum.

Truck performance formulas were given a thorough going over at another session. At still another, the old battles about what oiliness really is and does were fought anew with fresh supplies of ammunition promised for future engagements.

A trailer session brought much blunt speaking about the need for constructions and hitches which will make operation on the highway safe above 30 m.p.h. and about the utterly unsafe stopping performance of a car-trailer unit when the trailer

THE PICTURE ***at the top of this page*** **shows SAE President Harry T. Woolson surrounded by British participants in the Summer Meeting and British-born SAE members now prominent in our domestic industry. In the picture are: SAE Secretary and General Manager John A. C. Warner, J. H. Pitchford, W. E. Evans, F. L. Garton, H. C. Mansell, N. Mitchell, A. G. Marshall, and T. B. Rendel.**

unit does not have its own brakes – but, in this case, there was no disagreement. Everybody said in effect "You bet that's right!"

A frank presentation of safety in car design from one engineer to his fellow workers naturally brought opinion differences. It also brought from an important state traffic official the statement that set speed governors are "dangerous and hazardous," but a subsidiary desire for a flexible governor which would permit the driver to govern his own speed voluntarily. Then came the news that Chrysler has developed experimentally a flexible governor which can be set for a given speed, but so designed that the driver can push through the set speed by special effort under emergency conditions.

The hypoid gear session developed vigorously contending viewpoints about two schools of thought on lubricant characteristics and a plea for "working out" lubrication problems before new models come out, instead of "fighting them out" afterward.

Discussion was likewise profuse at other sessions of this vital meeting which covered almost every remaining phase of automotive engineering practice.

Car Body Design Objectives Debated

Opposing psychological viewpoints toward car body design were exemplified in the two papers at the Body Session at which SAE Vice-President L. L. Williams presided on Saturday evening. Count Alexis De Sakhnoffsky, engineering stylist, emphasized the injection of speed lines into car design to appeal to every man's underlying belief that he really would be a good race driver, while Frederic A. Seljé, Chrysler Corp., visualized body designing as an attempt to provide a moving room with homelike atmosphere. Design trends "disavow the wind tunnel," Count Sakhnoffsky said in his talk on "Artistic Streamlining Against the Wind Tunnel."

The wind tunnel wants a stubby front, he pointed out, but the designer has successfully introduced artificially long hoods. The wind tunnel dictates a broad front, yet never in the history of the automobile have radiators been so narrow. The wind tunnel suggests a vertical, rounded windshield, yet production cars have windshields slanted at a sharper angle each year.

"It is the *suggestion* of speed that charms the eye," Mr. Sakhnoffsky claims, "and this harmless make-believe is a powerful sales factor."

He believes also that "the racing car of today has a direct influence on the touring car of tomorrow."

It is suicidal for a manufacturer to leave the styling of his product to guesswork or to burden his designers with his own prejudices or whims. His design staff is truly a "staff of business life." Thus did Mr. Seljé stress the importance of styling in his paper, "Function in Modern Styling."

Beauty is obtained by intelligent use of materials and processes functionally correlated to produce form, proportion, texture and color, he said, not by adding gadgets and ornaments.

The interior of a car should reflect its exterior styling, Mr. Seljé believes, because when one approaches a Colonial building, for instance, he expects to find the interior and furnishings of the same styling or period. The radiator and hood louvres, being the principal exterior body features, should therefore employ the lines or motif around which to develop the interior scheme.

Commenting on some details of car interiors, Mr. Seljé expressed personal preference for two shades of one cloth, rather than the same cloth throughout the whole interior. The lighter shade, he thinks, should be placed on the sidewalls, door panels and ceiling; the darker on seat-backs and cushions.

Every possible safety measure should be incorporated in car interiors, Mr. Seljé concluded, saying that "the best we can provide is far from adequate. . . . All possible projections should be eliminated."

Can Design Changes Improve Car Safety?

Batting for the Passenger Car Activity, John H. Hunt, General Motors Corp., faced the headlight glare problem without blinking, walked squarely into the safety aspects of automobile braking, peered frankly at the limitations on vision in the modern car and looked at the safety problems involved in crash dangers, roadability, fatigue factors and other minor car construction angles. The occasion was the Safety Session on Thursday evening at which Sidney Williams, director of public safety, National Safety Council, presided, following a brief business session conducted by SAE President Harry T. Woolson.

No hope of real improvement in the lighting situation from the standpoint of safety is possible, Mr. Hunt said, except by recognizing that conditions have greatly changed since specifications were developed to secure illumination and prevent glare by the aiming of a single pair of fixed beam headlamps. "Our only chance," he said bluntly, "outside of introduction of radically new inventions, is to recognize that the opposing views as to what constitutes good headlighting – simply expressed as demand for illumination vs. demand for glare elimination – come from the fact that we have two fundamentally different conditions to meet, and that we must have really two lighting systems to meet these conditions."

A very large percentage of the drivers in the Middle West, he added, use these two systems which are incorporated in modern headlighting equipment without compulsion from the police.

As regards brakes, Mr. Hunt pointed out that there is a tendency to overemphasize maximum possible deceleration and to forget that brakes are used many times oftener to make minor adjustments in car speed than to stop.

Equal distribution of braking, he said, will tend to make the wear approximately equal – front and rear and overall service conditions are likely to be better. Any specifications covering brake performance, he added, should include an allowance for a reasonable amount of deterioration. He recommended that no specifications be adopted which require too high a percentage of that available from a 50-50 brake distribution for a 50-50 weight distribution.

Many present-day brake problems, he said, might be reduced by greater attention to cooling. Advances are to be expected, he said, because we probably have reached the limit of increase in car speeds and in shrinkage of wheel diameter, so that effort which formerly went to meet radical increases in requirements can go into refinement of detail.

He showed the changes in driver vision which have come about in recent years, pointed to the fact that the wide pillar posts have come as a result of lowered center of gravity which contributes to safety against overturning and expressed the view that limitations on vision probably contribute more to driver fatigue than to making driving actually unsafe. Windshield wipers, he said, do not clear as large a part of the windshield area as is desirable. Much of the adverse owner reaction about vision limitation, Mr. Hunt believes, may come as much from having a changed pattern of the area which the driver can see clearly as from actual reduction in the area.

He pointed to the many protections which have been incorporated in cars against crash dangers and discussed the vari-

ous types of injuries which occur to people involved in crashes. Modification of car design to reduce passenger injury in crashes requires considerable attention, Mr. Hunt believes. He urged an investigation by all companies on this subject.

Further improvement in ventilation, he said, will help reduce fatigue in drivers, although many contributions along this line have already been made. The automobile radio really is a safety factor, he indicated, because it helps to reduce boredom, the effects of which are frequently the same as are the effects of fatigue.

In the course of an extensive discussion of roadability as related to safety, Mr. Hunt indicated the desirability of a car which understeers as opposed to one which oversteers and voiced the personal belief that steering ratios may have gone too high. He concluded with discussion of various specialty gadgets which have been suggested from time to time as aids to safety. He rehearsed the dangers arising from governors due to lack of accelerating ability in passing other cars and said that compulsory use of direction signals might result in the giving of an increased number of false signals.

"Open minded discussion," he concluded, "among car engineers and public officials and safety engineers is necessary if real progress is to be made in improvement of car safety."

Dramatically illustrated discussion came from Dr. Claire Straith, Detroit plastic surgeon, who has specialized in repairing injuries suffered in automobile accidents. He showed pictures of injured cases and pointed specifically to various types of projections in automobile interiors which had caused them, urging that all possible interior projections be eliminated as rapidly as possible. The passengers riding in a vehicle which crashes, he said, are the ones usually hurt, the driver himself getting off with slight injuries in a majority of cases.

Dr. H. C. Dickinson, National Bureau of Standards, urged that legal responsibility for avoiding an accident should rest on the driver who is making a turn or doing the extraordinary thing, rather than on the man behind who is driving straight ahead. For this reason he opposes the use of direction signals.

Tests to determine the relations between beam candlepower and visibility distance were described by Val J. Roper, General Electric Co., the investigations being unique in that the drivers were unaware that they were being tested. Results show that a driver perceives an unexpected obstacle only half as far away as an expected obstacle and that 1000 cp. in the direction of the eye from opposing headlamps reduces the perception distance with present headlamps about one-third. Ten times this amount of glare reduces the perception distance about two-thirds.

"With higher wattages in the meeting beam," he emphasized, "it is possible to provide illumination along the right side of the road sufficient for reasonably safe seeing when meeting other cars and with glare relief at least equal to that of our present lower beams."

John P. Arnoldy, chief of the traffic control police, State of Minnesota, branded set speed governors as "dangerous and hazardous," but urged the possibility of a flexible governor to be controlled by the driver which would permit the driver to govern his own speed voluntarily in accordance with the speed zone in which he might be traveling at any given time.

A. G. Herreshoff, of Chrysler, said that his organization has developed a flexible type governor which can be set for a given speed, but so designed that the driver can push through the set speed by special effort under emergency conditions. He also discussed the possible need for different standard bumper heights.

Packard's assistant chief engineer, Earl H. Smith, emphasized the need for concentration on car design features to make operation easier and less fatiguing, while W. S. James, chief engineer of Studebaker, pointed to lack of data on the true relationship between speed and accidents. No speed is uniformly safe, he pointed out, for all areas and road conditions.

Austin M. Wolf, automotive consultant, decried the growing thickness of body pillar posts, pointed out that even the present two-way front seat adjustments leave something to be desired, and praised the unit type body construction as a safety advantage. He also urged positioning of speedometers so that they may easily be read.

Aircraft-Engine Trends Viewed from Two Continents

Graphic portrayals of future aircraft engines from both sides of the Atlantic – England and America – converged at the first Aircraft-Engines Session which opened the meeting on Tuesday night with Arthur Nutt, Wright Aeronautical Corp., as chairman. Inherent characteristics of in-line air-cooled aircraft engines and the effects of various operating conditions on flame travel in a gasoline engine were the subjects of the two papers taken up in the second Aircraft-Engines Session which was held the following afternoon and at which Ralph N. Du Bois, Aviation Mfg. Corp., Lycoming Division, was chairman.

In the next five years the general-purpose aircraft engine will give way to "horses of course" or specialized engines, presaged A. H. R. Fedden, Bristol Aeroplane Co., Ltd., in his paper, "Trend of Air-Cooled Aero Engines in the Next Five Years," as read by W. M. Evans, also of the Bristol organization.

This specialization, he continued, will be occasioned by a considerable step-up in performance generally and a greater cleanliness of design. Although indicating that the next five years will be a period of intense activity, Mr. Fedden believes that the development of an airplane engine will become a more expensive and prolonged undertaking and that it will be impracticable to make design changes as rapidly as in the past. This trend, he pointed out, "emphasizes the vital necessity of a wise choice when a new design of engine is in the project stage."

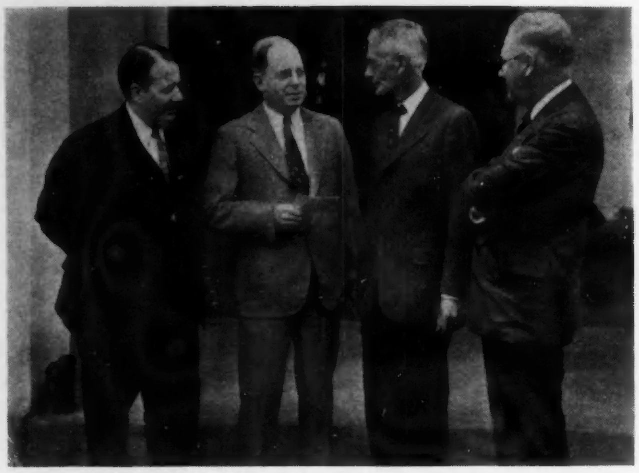
As the aircraft to be powered by future aircraft engines have a profound effect on engine design, Mr. Fedden first envisioned the most important types to be expected in the future, before proceeding with his analysis of coming engines.

"I cannot help but believe," he contended, "that the marked stepping up in performance of aircraft during the last few

Past-Presidents Exchange Greetings

Horace Marlatt with SAE Past-Presidents Ralph R. Teetor and William B. Stout

An Impromptu Conference



SAE President Harry T. Woolson (*with paper*) talks things over with John A. C. Warner, secretary and general manager, (*left*), Past-President Henry M. Crane and William J. Davidson, chairman, Engineering Relations Committee.

years must level out and gradually slow up and, therefore, no very drastic changes in layout will be made in the next five years."

Specifically Mr. Fedden believes that "the classic Douglas type" will be continued in variant forms, larger sizes, and with a greater number of engines.

"Not in the best interests of aviation," is Mr. Fedden's opinion of recent extravagant estimates of radical changes in design and performance in the near future. "A wiser mental attitude would be," he believes, "to recognize that there are natural limits to progress at any given stage of development – but to refuse to regard them as rigid and immutable barriers."

Returning to his forecast of engines Mr. Fedden came down to cases: "Speeds of 400 m.p.h. and more may be envisaged without coming into the danger zone of the compressibility burble," he announced, but added that stratosphere flying will not be current practice, with a few military and commercial exceptions. Engine production will be standardized, he predicted, suggesting four types of air-cooled engines of 750, 1150, 1500, and 2000 hp., and comparing radial and in-line designs. These engines will weigh just a little more than 1 lb. per hp. 100-octane fuels will be standard then, he continued, and we can expect an increase in horsepower of about 25 per cent and decreased consumption of about 7 per cent, from them.

Looking at the Diesel aircraft engine in the next five years Mr. Fedden pointed out that improvements in carburetor engines and fuels will make the case of the Diesel "more difficult to substantiate." On the other hand he stressed the advantages of the Diesel, especially the decreased fire risk and lower fuel consumption, and deplored the fact that greater emphasis is not placed on compression-ignition research in England.

Focusing attention on the importance of ease in production, Mr. Fedden warned: "We must not let our enthusiasm for too small cylinders get away from us, as such reductions are accompanied by increases in cost of production."

After startling listeners by the statement that the drag of the cooling air flow may become a helpful thrust at very high speeds, Mr. Fedden explained how the cooling system acts as a heat engine under these conditions.

"Standardization of all components is a pressing need of the aircraft industry today," Mr. Fedden believes, stating that this purpose will be aided by the ascendancy of the Douglas type with power units localized on the plane wings.

Engines may be installed in the wings in the next five years, he concluded, but the wings will have to be thick enough to accommodate existing types with little change, as a complete changeover is out of the question in such a short time.

"At least 50 per cent greater output will be provided by further development of existing aircraft-engine types," estimated George J. Mead, vice-president and chief engineer, United Aircraft Corp., in the second paper of the session, "Powerplant Trends," which gave the American view of future developments. The paper was read by L. S. Hobbs, engineering manager of the same corporation, in the absence of Mr. Mead who was in England where he had just presented the same paper before the Royal Aeronautical Society.

The present rate of progress in development can be maintained at the same rate, he predicted, "provided our invaluable allies, the chemist, the metallurgist, and the fuel technician, can keep pace with our needs."

The trend toward smaller cylinders for the higher outputs, combined with the general acceptance of the two-row type, has effected a decided reduction in frontal area per horsepower, he explained.

"Evident future needs for engines of from 2000 to 3000 hp. have focused attention on employing a greater number of cylinders to obtain the desired added displacement," he continued. These needs may result in two new types, predicted Mr. Mead, the cylindrical or multi-row radial and the rectangular or flat multi-bank in-line engine. A net saving in the fuel bill of as high as 20 per cent is looked for by Mr. Mead from the combined reductions in powerplant drag and further improvement in specific fuel consumption.

In predicting slow and gradual evolution in aircraft-engine development instead of radical changes, for the immediate future, Mr. Mead saw eye to eye with the view expressed by Mr. Fedden in the preceding paper, said he: "Development must continue to be a steady step-by-step process . . . . the problems are more complex than ever before and require both greater time and more expense for their solutions . . . . aviation has at last settled into its stride."

Continuing, Mr. Mead discussed detailed trends in powerplants function-by-function and part-by-part. Speaking of fuels he believes that their improvement is "the greatest single aid in bettering engine performance during the past ten years . . . . and that the general adoption of 100-octane fuel can be safely predicted." Of cooling he feels that "there is every indication that blower cooling will permit carrying the power of air-cooled engines considerably higher . . . . more means must soon be provided to cool the spark-plug." The exhaust-driven turbo supercharger was pointed out by Mr. Mead as being best able to meet future requirements. The advantages of sleeve valves at the higher crankshaft speeds of the future were stressed by Mr. Mead.

"Powerplant development can and will keep pace with requirements," was his optimistic conclusion.

H. L. Brownback, consulting engineer, in written discussion, was "struck by the difference in the mode of attack of the two papers." However, he did not believe the difference surprising in the light of the fact that the preponderance of European engines had to be built to satisfy military requirements and thus tended toward specialized design whereas, with American engines built for transport service, cost is more of an item, he reflected. Differing with Mr. Fedden's belief that the trend would be away from the single-engine types, he pointed out that the pursuit or "destroyer" type of military craft that employ a cannon that shoots through the propeller shaft must of necessity continue to be a single-engine type.

Data that led to the startling conclusion that maximum pressures of boosted spark-ignition engines ran up almost as high as those of compression-ignition engines were disclosed by

Carlton Kemper, National Advisory Committee for Aeronautics, in discussing Mr. Fedden's comparison of these two aircraft-engine types. If this factor were taken into account, he pointed out, the comparison would be more favorable to the Diesel engine as Mr. Fedden's whole argument is based on the greater weight of the compression-ignition engine. Work at Langley Field shows, he continued, that the compression-ignition engine likes boost, so that the amount of boost is limited only by cylinder pressures. Also Mr. Kemper contended that increases in octane number do not reduce specific fuel consumption to any appreciable extent, rather that they work almost entirely toward increasing power.

H. C. Mansell, Bristol Aeroplane Co., Ltd., told of his researches with aircraft compression-ignition engines, describing one design of small power that holds an altitude record.

Answering Mr. Brownback, Mr. Hobbs reported that they were endeavoring to find out whether a cannon will be used on single-seater pursuit planes. Concerning the spark-ignition-compression-ignition comparison he pointed out the maintenance record of the former type in transport service where the only work necessary in a 600-hr. run is to overhaul the spark-plugs every 60 hr. Noting that Mr. Fedden's drag figures were higher than those given in Mr. Mead's paper, he recommended more study to find out which data are correct.

Characteristic features of the in-line type of aircraft engine which make it particularly suitable as an engine of high output were pointed out by A. T. Gregory, Ranger Engineering Corp., in his paper, "The In-Line Air-Cooled Aircraft Engine."

"The in-line air-cooled engine," he explained, "is an engine that is supposed to cool perfectly even though the front cylinder shuts off the cooling air from the rest of the cylinders. Its front area is small so that it should fit into almost any fuselage without increasing the frontal area. It should allow perfect visibility and have a high thrust line. In the higher horsepowers particularly, the in-line engine should be lighter than other types and should require comparatively little servicing."

"The in-line engine is basically a high-speed engine," contended Mr. Gregory, "and there does not appear to be any

Meeting Draws Men from All Branches of the Industry

Top row, L. C. Eldridge, T. C. Smith, John H. Hunt, Col. Herbert W. Alden, Harold Nutt.
Bottom row, Val J. Roper, W. S. James, E. W. James, J. Willard Lord, Clinton Brettell, Robert N. Falge.

particular advantage in rating it at less than 3000 r.p.m. for very high outputs. Rather, there are very decided advantages to be gained from an increase in speed above this value."

Referring to Mr. Gregory's statement that all high-output engines develop approximately 0.7 hp. per cu. ft. per min. piston displacement regardless of size, number of cylinders, or cylinder arrangement, N. N. Tilley, Continental Motors Corp., pointed out in prepared discussion that this statement is apparently the same as saying that all engines develop the same brake mean effective pressure. This condition may occur for a given octane fuel, he conceded, although data presented elsewhere indicate an appreciable variation in brake mean effective pressure with cylinder size, temperature of air-fuel mixture, and other design factors or operating conditions. If more cylinders make lighter engines, other explanations can be used instead of the argument presented, he concluded.

"If an in-line engine is jacketed completely as shown in Mr. Gregory's paper, the advantage of turbulent flow is lost and more power is required to cool," claimed Mr. Kemper. To back his contention he told of tests on cowled single cylinders using the same pressure drop employed in multicylinder tests in the wind tunnel that did not show as effective cooling because, he explained, we found we were not duplicating conditions.

"I am afraid Mr. Gregory has fallen into a trap on the subject of the trend of weights with increasing number of cylinders," suggested W. M. Evans, Bristol Aeroplane Co., Ltd., contending that Mr. Gregory's data show an increase in specific weights with increasing number of cylinders instead of a decreasing trend as interpreted by Mr. Gregory. As the Napier 24-cylinder engine is a well-developed type, its higher specific weight should be considered as such, he explained.

"The agony of lubrication increases as the square of the speed," claimed S. D. Heron, Ethyl Gasoline Corp., taking issue with Mr. Gregory's contention that the higher speeds of the in-line engines would simplify lubrication problems. He pointed out, also, that the enclosed lubricated valve gear is not a sole development of the in-line engine, but was developed simultaneously for several types about 1924.

The cooling and bearing arrangement shown seems "deceptively simple," contributed A. L. Beall, Wright Aeronautical Corp., opining that it would become more complex as the number of cylinders increase.

Mr. Tilley is correct about brake mean effective pressures, agreed Mr. Gregory in summation, as is Mr. Heron in that both radial and in-line engines have enclosed valve-gear lubrication in common. He defended his position as regards fewer lubricating problems at high speeds by stating that it is apparently possible to operate without ring-sticking at higher revolutions per minute. On the subject of trends in specific weights with increased number of cylinders, he reiterated his belief that the weight of the Napier 24-cylinder engine can be lowered considerably with further development.

Flame speed in an Otto-cycle engine decreases with increasing altitude in an unsupercharged engine, with increasing inlet temperature, with increasing humidity – flame speed increases with supercharging, or with reducing the exhaust pressure with inlet pressure constant – concluded C. L. Bouchard, summarizing the results of the paper: "Altitude and Other Variables Affecting Flame Speed in the Otto-Cycle Engine," prepared by himself, C. Fayette Taylor, and E. S. Taylor, all of Massachusetts Institute of Technology.

The increase in flame speed with reduction in exhaust pressure is undoubtedly due to the decreasing proportion of residual exhaust gases in the mixture, he explained in his interpretation of results. The effects of various operating conditions on the rate of flame travel across the combustion-chamber were determined, he related, by means of flame-trace photographs taken on a moving film and made through a glass-window slot in the cylinder of a small L-head single-cylinder engine.

We found, Mr. Bouchard continued, that the initial period of slow burning at the start of combustion occupied about 10 per cent of the distance across the combustion-chamber, explaining that the flame speed during this initial period was figured separately from the average flame speed during the rest of its travel.

"It appears that combustion-chamber shape, spark-plug location, heat transfer, and piston motion are also factors which influence flame travel," concluded Prof. L. C. Lichty, of Yale University, in prepared discussion in which he related their theoretical and practical effects.

Explanation for some of the paper's results was suggested in written discussion by Charles F. Marvin, Jr., National Bureau of Standards, as read by H. K. Cummings, also of the Bureau. It is very difficult, he stated, if not impossible, to isolate completely the independent effects of pressure and temperature in an engine. Moreover, he continued, measurements of the spread of the flame cannot be analyzed to yield accurate values of the speed of propagation of the unburned charge – the fundamental speed of greatest interest. However, he went on, this fundamental "transformation velocity" can be calculated from observations of the spread and the development of pressure in a spherical bomb with central ignition. It is hoped, Mr. Marvin concluded, that data showing these effects will soon be obtained using apparatus now being constructed by the National Bureau of Standards, with the support of the National Advisory Committee for Aeronautics.

Interpretation of the data is very vague, feels Robert N. Janeway, Chrysler Corp., taking issue with the paper's conclusions that flame speed is the only factor that determines the rate of pressure rise and that the flame speed is assumed to be constant during 85 per cent of its travel. Generalizations are dangerous, he concluded, because the combustion-chamber shape used is not representative of service engines, lacking their turbulence.

Mr. Janeway's criticism of the combustion-chamber used was answered by both Mr. Bouchard and Mr. Du Bois who explained the difficulty of constructing a combustion-chamber that can be seen through and still be representative of service engines designed for greater turbulence.

Aircraft Radio Shielding Judged "Too Elaborate"

Present aircraft radio-shielding practice was indicted as being unnecessarily complicated and costly in one of the three papers presented at the Aircraft Radio-Shielding Session directed by A. L. Beall, Wright Aeronautical Corp., session chairman. In the other two comprehensive investigations of mica spark-plugs and the character of the spark discharge were reported.

"Little or no effort has been expended to determine the extent to which an airplane should actually be shielded," contended Harold E. Gray, American Airlines, Inc., in his paper, "Radio Shielding," which presented the results of practical experience in airline operation. "In many cases the practice has been overdone just to be on the safe side," he continued, "or to sum the matter up, a ship is shielded largely on suspicion."

Although conceding that highly efficient radio operation that is relatively interference-free is now being enjoyed, Mr. Gray feels that such operation is obtained only by constant vigilance and at a far greater cost than if the deserved amount of consideration and attention were given to the subject.

All shielded ignition harnesses are basically the same, he

explained, and may be divided into two classes: those using a common shield or manifold from which the individual wires are distributed by means of flexible leads designed to have shielding properties, and those employing individually shielded conductors.

Commenting on the neglect of radio shielding deplored by Mr. Gray, E. E. Husted, Titeflex Metal Hose Co., in prepared discussion, suggested that several manufacturers of radio-shielding equipment are now in a position, as a result of considerable research, to render valuable consulting service and should be called in for advice before a new model of an engine is released. He also presented details of radio-shielding equipment to supplement those given by Mr. Gray.

Rising in defense of the aircraft manufacturer H. H. Bruderlin, Douglas Aircraft Co., reported the extent of research work that is being carried out on radio-shielding problems.

Other discussers were A. T. Gregory, Ranger Engineering Corp., and A. L. Beall who termed the paper "a severe indictment of radio-shielding design."

Three methods for measuring the discharge current of automotive ignition systems using the cathode-ray oscillograph were presented by George F. Blackburn in the paper "Electrical Character of the Spark Discharge of Automotive Ignition Systems," by Mr. Blackburn, Dr. Melville F. Peters, and Paul T. Hannen, all of National Bureau of Standards. These methods are by measuring the voltage drop across a resistance, by measuring the voltage drop across an inductance, and by deflecting the cathode beam magnetically by means of coils introduced into the circuit, he explained. The study was sponsored by the Bureau of Aeronautics of the Navy, he announced.

"One of the primary objects of this work," he stated, "is to develop technique which can be used to determine the character of spark discharges of automotive ignition systems without appreciably disturbing the ignition circuit."

After showing agreement between measured and computed values of current and voltage, Mr. Blackburn concluded:

"The spark occurring in the secondary circuit of a spark generator on interrupting the primary current usually consists of a number of separate discharges, each of which may consist of a capacitive and an inductive component. In each discharge the decay of the current in the inductive component, if such a component is present, is followed by the rapid rise of resistance in the gap, whereupon the capacitance is again charged to such voltage that the discharge is repeated. The spark ends when there is no longer sufficient energy in the secondary winding to charge the capacitance to the breakdown voltage."

"A spark is a spark as far as igniting the charge is concerned," believes Walter J. Spengler, Scintilla Magneto Co., Inc., the first discusser, "and amperage has no effect on flame propagation in the engine." Referring to measurement of the maximum current, he reported that 20 amp. is the highest value that he had been able to measure, although conceding that it is probably as high or higher than that computed in the paper.

The final paper of the session, an exhaustive report of the cooperative efforts of the Bureau of Aeronautics of the Navy Department, the National Bureau of Standards, the SAE, and the Naval Aircraft Factory at Philadelphia, entitled: "An Investigation of Mica Spark-Plugs," by Dr. Melville F. Peters, H. Kendall King, and John P. Boston, all of the National Bureau of Standards, was summarized by Dr. Peters. He explained the various steps of the "simplified" mathematical analysis of the heat flow employed, and discussed the related problems of thermal expansion.

Recalling that he flunked hydraulics in his college days because of too many K's, Otto C. Rohde, Champion Spark Plug Co., feels the same way about the mathematical analysis in the paper: "too many K's with assumed or computed values."

"The assumption throughout the whole paper is that mica plugs are desirable," he continued, "but my experience does not confirm it because the right kind of mica is too hard to get in sufficient quantity." The logical approach to the problem, he suggested, is to try to develop substitutes for mica. Mr. Rohde concluded his discussion with a plea for more cooperation from metallurgists and chemists in the quest for this new material.

Answers to A. T. Gregory's inquiry as to the possibilities for future development in reducing the size of the plug came from

On the Grounds of The Greenbrier

Mr. and Mrs. E. Y. Watson

David Beecroft and H. L. Brownback

several sources. Mr. Rohde reported that reduction in size of the plug had the disadvantage of lowering the strength of the steel and, therefore, required a material of lower heat conductivity, whereas Dr. Peters replied that results with smaller plugs gave just as good results, except for lower mechanical strength.

In reply to Mr. Rohde's remarks on spark-plug materials, Dr. H. C. Dickinson, National Bureau of Standards, explained that the work did not necessarily recommend the use of mica spark-plugs, stating that a similar investigation on porcelain plugs is now in progress.

Trailers Bring Nightmare Problems to Car Makers

Answering the question, "What the Trailer Means to the Car Manufacturer," James H. Booth, Buick Motor Co., said that when 2500 or more pounds of trailer are added to the car designer's problems he may be expected to have unpleasant dreams. "Every additional pound of weight is a nightmare." George L. McCain, Chrysler Corp., presided at the session.

Practical ways of modifying the particular cars which are going to pull trailers to make them more satisfactory were suggested by Mr. Booth as a result of experimental studies. "Some units," he stated nevertheless, "just cannot be helped and will have to suffer until the trailer industry absorbs a sufficient percentage of automobile production to warrant special equipment on cars intended for this purpose."

A suitable hitch is the car designer's major and first problem, Mr. Booth said, thus indicating that the SAE started in at a vital point when it set up a cooperative committee with trailer manufacturers to seek hitch standardization as its first activity in the trailer field.

Mr. Booth's paper is published in full on pp. 221-224, Transactions Section, this issue.

Another step toward final action on standardization of tourist trailer couplings was taken when committee chairman A. G. Herreshoff reported at the Trailer Session widespread approval from a majority of trailer, car and couplings manufacturers of the tentative recommendations for a standard proposed by his committee last January.

Analyzing replies from 44 companies to a request for approval or comment on the committee's recommendations (see SAE Journal, February, 1937, p. 54), Mr. Herreshoff said that every one of the eight points in the specification had approval from more than 75 per cent of those answering. He rehearsed the various points in the specifications, read details of unfavorable comments which had been made on some of them and asked for further written discussion from interested parties to be used by the committee in attempting to arrive at a finally satisfactory revision.

Trailer manufacturers, car engineers and special investigators were unanimous in discussion condemning the use of tourist trailers without brake equipment. E. B. Neil, N. W. Ayer & Co., told of emergency stop tests which he had made on trailers equipped with brakes and without brakes. The results showed the car to be almost impossible to handle in a sudden stop from 50 m.p.h. when the trailer brakes were disconnected. With the trailer brakes connected, stopping was extremely smooth and even. Similar results were cited by M. H. Carpenter, Split Coach Motor Corp., of emergency stop tests from 40 m.p.h. In this latter case, the deceleration rates were better for the car and trailer with trailer brakes attached than for the car alone.

Discussers agreed, too, that trailer construction and hitches must be so developed that operation of car-trailer units will be entirely safe at speeds in excess of 30 m.p.h. – and that this was not the case in many present instances. Henry M. Crane, General Motors Corp., was the most emphatic speaker on this point. He emphasized also his belief that there is great danger to roadability and handling when any heavy weight is attached to the rear of an automobile – including, in his opinion, an engine in the rear of the car unless engines much lighter than those now available are developed. The business coupe, he said, is the car model which can best be adapted to a proper hauling of a tourist trailer.

Need for adequate tire capacity was another element strongly emphasized throughout the discussion. W. I. Ford of U. S. Rubber Products, Inc., said that rear tires on a car hauling a trailer wear twice as fast as normally and that the front tires last one-third longer. Hauling a trailer, Mr. Ford said, gives the possibility of 45 per cent overload on the car rear wheels. B. J. Lemon of U. S. Rubber Products, Inc., suggested that car manufacturers should work out recommendations for proper tire inflations for their cars when trailer is and is not attached.

Dangers to safety from a rear tire blowout while hauling a trailer were said by several speakers to be more serious than from front tire blowout.

Along Trailer Row

Seven manufacturers exhibited nine passenger-car trailers at the trailer exhibit held on the grounds of The Greenbrier during the Summer Meeting. Those participating included the Auto Cruiser Co. of America, Bender Body Co., Covered Wagon Co., Hayes Body Corp., Royal Wilhelm Co., Split Coach Motor Corp., and Stout Engineering Laboratories. Interest centered on "trailer row" following the Trailer Session, Friday morning.

Sees Comeback of COE Truck Due to Legal Restrictions

"SWC" may become the new name for cab-over-engine trucks. If it does its origin can be traced to the T & M Wednesday morning session at which Pierre Schon, General Motors Truck Co., Austin M. Wolf, automotive consultant, and Robert Cass, White Motor Co., presented papers on the subject. Schon, Wolf, Cass – "SWC." SAE Vice-President John M. Orr conducted the meeting.

The truck industry had its start with the cab-over-engine or engine-under-seat, type of truck, said Mr. Schon, who spoke first. As evidence he quoted from a 1911 catalog the following selling points of that day: less overall length and shorter wheelbase for a given length of loading space; greater facility in handling in congested traffic; less space required for storage, at loading platforms and in streets, and better distribution of load.

Only three more points are needed, he added, to adequately cover the advantages of the modern cab-over-engine truck

A Summer Meeting Group with Casino in Background

Top row, Karl M. Wise, J. B. Macauley, Jr., Sydney Bevin, P. J. Kent, Robert M. Critchfield, George A. Round, J. P. Stewart
Bottom row, J. L. Stewart, Col. W. G. Wall, H. C. Mougey, Carl J. Bock, W. L. Shaffner

namely: greater safety – because of greater visibility; advantages in meeting legal size and weight restrictions; attractive appearance and greater advertising value.

The appearance of early-day trucks of this type, he maintained, probably led to their abandonment in America, although European manufacturers continued to build them. Such advantages as shorter length and better load distribution were of lesser importance, he explained, because there were no drastic size and weight restrictions, no problems of load distribution due to legal axle-weight limitations; and as solid tires were standard equipment there was no important tire-overloading problem.

These advantages are now of great importance and the place of the cab-over-engine truck is being firmly re-established, he declared.

Mr. Schon spoke of converting a standard ½-ton standard chassis, which would ordinarily take a 135 cu. ft. panel body, to a COE type of truck with a special 257 cu. ft. body for a body operation where body-load space means more than payload capacity as "one of the most outstanding examples of increase in utility value." He made computations to show that with the assumed list price of $700 for the conversion and the custom-built body, against the factory cost of $229.50 for the standard panel body, the COE type shows a price advantage of 37 cents per cu. ft.

In concluding he stated, "Up to 1937 the comeback of the COE type was handicapped due to limited production and excessively higher prices in comparison to the conventional type. . . . These ultra-modern vehicles are now available at a much lower cost differential, primarily due to larger production volume. . . . Should this trend continue it is quite possible that its many operating advantages and greater utility value will make a place for the COE in transportation to the extent where the question may arise in future years: 'Is there a place in transportation for the conventional type of truck?' "

Mr. Wolf, in speaking of "Cab-Over-Engine Trucks, Their Status and Design," warned that we must keep our feet on the ground and not permit the artist to sacrifice accessibility and vision for mere appearance, although the hiding of many chassis details such as shackles, springs, frames and brackets imparts an esthetic touch to which even a truck, in most of its applications, should not be immune.

Mr. Wolf noted that the inherent good visibility possibilities, due to the higher location of the driver and the elimination of the conventional long hood on the COE trucks, have been nullified in some designs by the cut-off due to the relatively high location of the bottom of the windshield. A "V" type windshield, he added, works to good advantage, particularly when the bottom side corners are lower than the center. He suggests that, as visibility is so closely allied with safety, some disinterested source should develop visibility data for presentation at some future SAE meeting.

The speaker noted that the sleeper-cab and the five or six-man cab fit in very well with the COE truck, since the additional length required does not encroach upon the body length which would be used on a comparative conventional truck. He believes that insulation of the cab from the engine compartment on the score of heat and fumes has been well carried out in view of previous experience on bus design.

Many designs, he said, provide for a removable powerplant which can be slid forward after removing the radiator grille and the front enclosure plate, as the engine, including the radiator in most cases, is mounted on a removable sub-frame. Thus, he explained, major repairs can be made on it, although in most instances the customary servicing can be done without removal.

Mr. Wolf stressed that the shortened wheelbase of this type of truck, and the approach of the center of gravity of the load toward the front axle has brought about a rather abrupt change in dynamic weight distribution. This, he said, makes conditions more critical than in the case of conventional design which is less sensitive to weight transfer, thus adding to the braking problem. Not only is greater weight transferred forward, he pointed out, but the same amount is subtracted from the rear.

In discussing the riding qualities of the COE type of truck, Mr. Wolf stated that to obtain good riding comfort in a truck in which the load may continually vary and/or range from full load to no load has always been a real problem. This, he said, has been emphasized in the COE truck and can only be alleviated by refined suspension design. Mr. Wolf believes that some form of multi-stage front spring suspension is a possible solution.

Mr. Wolf concluded with the observation that the COE truck is ideally suited to many applications. As in any new endeavor, he continued, it has had to pass through a period of "growing pains." He paid particular tribute to "a worthy and distinct pioneer in this field – the Autocar Company."

Maintenance costs of COE trucks keep pretty much in line with those of modern conventional trucks, maintained Mr. Cass, in his paper on COE truck maintenance. In preparing his paper Mr. Cass collected a number of statements from engineers which bore out his conclusions. It is generally agreed, however, he added, that time and accounting systems have not permitted collection of complete comparable data.

Ordinary adjustment of the distributor, changing of sparkplugs, attention to water pump and the normal accessories of the engine can be done in about the same number of moves in the COE truck as a modern conventional model, he said, adding that in some of the conventional models with high fenders the accessibility is not as good as in the COE.

Mr. Cass also pointed out the advantages in removing the powerplant which in many COE models is mounted on a subframe and slid out from the front with the radiator and transmission as part of the general assembly. Because of the compactness of the COE sheet-metal and cab set-up there is much less trouble from cracking of fenders or other sheet metal parts, the author stated.

B. B. Bachman, Autocar Co., a former SAE President, was first called upon to discuss the papers. He expressed the views of several discussers in calling Mr. Schon's prediction that the COE may completely supplant the conventional type of truck as we know it today, "a bit optimistic." Mr. Bachman made known his belief that the mounting of the powerplant so that it can be easily removed does not pay for itself. This was supported by several operators who mentioned that it is rarely necessary to take out the powerplant except for major overhauls.

T. C. Smith, American Telephone and Telegraph Co., granted that COE type of truck has advantages for some applications and remarked that the future depends upon the degree that some of the present-day objections to this type of truck are overcome. Among the adverse features from an operator's point of view, he mentioned that the original price is considerably higher, that space in the cab is lost to the engine shroud on some models, and that it is often so placed that the driver dismounts from the left, into the traffic stream. There is limited room for a propeller-shaft power take-off for operat-

Catching Action During Field Day Events

Aiming the movie camera is President Harry T. Woolson. The candid-cameramen are C. W. Spicer and Arthur W. S. Herrington

ing a winch and the installation is difficult, Mr. Smith said, also mentioning that in some models the transmission extends into the body of the truck. This, he said, makes it difficult for both body builder and user.

Col. G. A. Green, General Motors Truck Co., noted that when his company first built COE trucks they designed them so that the engine could be easily removable. The sales department, he said, asked that expenditures in this direction be curbed as the cost of such installation was not warranted.

Fred B. Lautzenhiser, International Harvester Co., in prepared discussion stated that the COE unit is entirely unsuited for the largest user of motor trucks – the farmer. Nor should it be used, he said, in other applications where travel is over soft terrain.

Fred L. Faulkner, Armour & Co., told about the 60 or 70 COE trucks operated by his company. These, he said, are used primarily in crowded urban centers, cost about the same to maintain as the conventional present-day truck – but more than of trucks of several years ago due primarily to the more simple design of that time.

H. O. Mathews, Public Utility Engineering & Service Corp.; A. J. Scaife, Autocar Co.; Clinton Brettell, R. H. Macy & Co.; Mr. Walters and J. G. Holmstrom, Kenworth Motor Truck Co., also took part in the discussion.

Let Manufacturers Design Trucks, Purchasers Urged

The time is past when truck purchasers adapt their operating schemes to the limitations of the vehicles available, Merrill C. Horine, Mack Mfg. Corp., told those attending the Thursday morning session in his paper on "Fundamentals of Vehicle Performance." Instead, he said, the manufacturer now must adapt the vehicle to meet the requirements established by the purchaser. This can best be done, he declared, if the purchaser tells the truck manufacturer what he wants the truck to do, and leaves the rest up to him.

Defining performance as the rate of maintenance of motion against resistance arising from road surface, grades, snow, wind and traffic, the speaker believes that the greatest impedance of performance is traffic.

Regarding performance rating Mr. Horine spoke of the ability factor which, he said, is generally understood to mean the tractive effort delivered at the rear tires, divided by the product of 20 times the gross vehicle weight, in tons, and the Meyers tractive formula, which in essence is virtually the same thing. Drawbacks to these forms of ratings, he explained, are that they are: – based upon the peak torque of the engine, which occurs at an engine speed which is below that at which competent drivers operate; provide no margin for loss of maximum torque output as result of loss of motive power efficiency between overhauls; are dependent upon the manufacturer's rating which may or may not be optimistic; take no account of speed; have to be worked out individually for each ratio and gear change; and are not subject to fair comparison because of variations in total gear ratio which affect the result.

Another method described is to express performance in terms of grade ability at 20 m.p.h. This, he pointed out, cancels out the factor of variable ratios but is still based upon peak torque or manufacturer's rated torque.

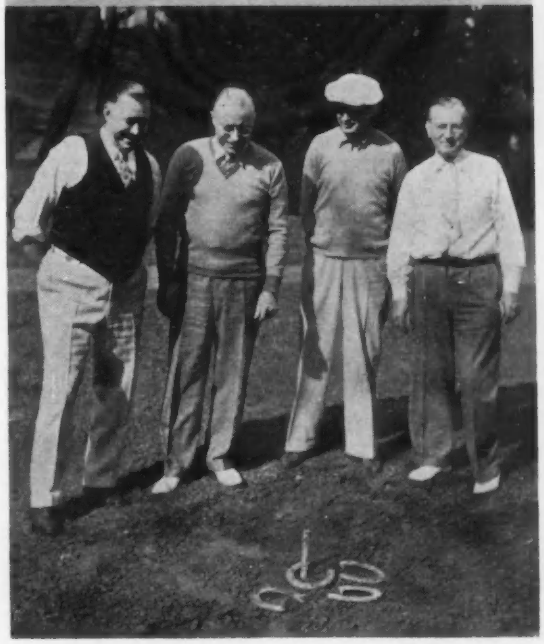
None of these three methods, he declared, permit direct comparison between different vehicles except when definite allowances are made, and they do not readily permit direct interpretations in terms of operators' problems.

Offering important advantages over other known methods, stated Mr. Horine, is the method of rating devised by the SAE Rating Committee. This yields a performance factor, in the

Golf and *Barnyard Golf*

C. V. Williams
V. C. Young

J. J. Cooper
Frank Jardine



K. D. Smith
E. H. Smith
J. Harold Hunt
J. C. Tuttle

form of an index figure, which is directly comparable between different vehicles and which permits the determination of grade ability and speeds under any given conditions, he maintains.

This method, he said, eliminates the manufacturer's claim as to torque and substitutes a formula based upon prevailing torque per cubic inch of piston displacement in truck engines; provides a further correction of torque developed at governed speed, rather than at the relatively slow peak torque speed; and, finally, the formula is simple to use.

This stressing of performance formulas, he declared, is to emphasize the fact that horsepower-to-weight ratio is the basic fundamental of performance, and no amount of manipulation of gears or axles can affect this basic relationship to performance ability. However, Mr. Horine added, while fundamentals are indispensable, they alone are not sufficient, and the matter of gear reduction is without question, the most important single factor contributing to satisfactory performance, excepting the power and torque of the engine alone.

Warning against fallacious notions concerning the effects of different arrangements of gear reductions, he said that perhaps one of the most popular delusions has to do with the effect on performance of overgearing in transmission or auxiliary. He showed that the overgeared transmission offers no virtues in itself, and that it results in speeding up the driveshaft speed over that of the crankshaft – speed that spells trouble with the giant joints required for heavy trucks. Also that it causes greater churning of lubricant and that it involves the use of smaller pinions, whose pitch lines, being of a smaller radius, result in higher tooth pressures from the same input torque and whose lesser number of teeth means greater rate of wear.

There are instances, he said, where transmissions in use do not have adequate ratio range. In such cases, he maintained, the use of auxiliaries, either in the form of extra transmissions or two-speed axles are the only alternatives. It should be clearly understood, he continued, that these can never be anything more than a makeshift to compensate for an inadequate ratio range in the main transmission.

In concluding he expressed his hope that purchasers of motor transport equipment will avoid specifying means by which results may be obtained, and, instead, specify the results which must be secured, leaving the selection of the proper units to accomplish the results up to the truck manufacturer.

Stephen Johnson, Jr., vice-president representing the Truck, Bus and Railcar Activity, who was session chairman, opened the discussion by reading comments submitted by B. B. Bachman, Autocar Co., which bore out Mr. Horine's contention that the fundamentals of gear reduction are not generally appreciated. Mr. Bachman does not agree that the case for the overdrive box is as dark as the author pictured it. The problem of propeller shaft speeds, he believes, can be handled. He feels that although the pinion size is a factor in the axle, it is balanced by the greater torque impact to which the pinion is subjected to with the direct-gear box. Likewise, his opinion is that the increased loading on the spigot bearing of the mainshaft and the first-speed pinion on the countershaft calls for a heavier and more costly overall design to provide equal capacity in the direct-drive box as compared to the overdrive.

A number of discussers pointed out that state legislators are taking more and more interest in performance ability, and that some proposals being considered are quite unreasonable. F. B. Lautzenhiser, International Harvester Co., predicted that the majority of states will have requirements for grade ability and stopping ability. He added that gross weight may eventually be controlled by performance ability.

Austin M. Wolf, automotive consultant, commented on the unreasonable demands of operators who want trucks with passenger-car performance. Such trucks, he added, would be all engine.

Fred L. Faulkner, Armour & Co., believes that most operators try to follow Mr. Horine's suggestion of leaving the specifications up to the manufacturer, but, he added, in some instances they cannot get the desired gear boxes because the truck manufacturer doesn't make them. They find it necessary to substitute two-speed axles or something else. His company specifies ability to climb a 3½ per cent grade at 20 m.p.h. Good performance on hills, he feels, is good business, as slow trucks holding up traffic on hills create ill will toward the company that operates them.

Mr. Horine answered a question by Robert Cass, White Motor Co., as to operator's problems on the Pacific Coast, by saying that the severe conditions met by them and certain other operators are comparatively rare, and that their purchases are but a small part of the total market. For that reason the mass production manufacturer does not build a truck to operate under such conditions and those operators who must face them have no other alternative than the adoption of auxiliary devices.

Others taking active part in the discussion were T. C. Smith, American Telephone & Telegraph Co.; Capt. O. A. Axelson, Columbia Gas & Electric Corp.; Pierre Schon, General Motors Truck Co.; K. D. Smith, B. F. Goodrich Co.; F. K. Glynn, American Telephone & Telegraph Co., and L. Ray Buckendale, Timken-Detroit Axle Co.

States Need for Crankcase Oil Temperature Control

"The purpose of controlling crankcase oil temperature is to provide better engine lubrication and thereby reduce engine wear, and improve engine performance and economy." Thus Ellis W. Templin, Los Angeles Department of Water & Power, the sole speaker at the Wednesday evening session, introduced his paper on "Crankcase Oil Temperature Control." F. L. Faulkner, Armour & Co., was in the chair.

Mr. Templin presented a mass of data obtained from studying those trucks in his fleet which operate over the torturous runs from Los Angeles to Boulder Dam, and along the Los Angeles Aqueduct into the High Sierras. On these trips the elevations vary from 200 ft. below sea level to 8000 ft. above, and atmospheric temperatures range from —26 deg. fahr. to 130 deg. fahr. Road conditions, he reported, include congested city traffic, paved high-speed highways, desert sand roads and heavy snow.

In his paper Mr. Templin took 60 sec. Saybolt Universal as the minimum permissible crankcase-oil viscosity. He also noted that engine performance is poor and cylinder wear greatest at cylinder temperatures below 140 deg. fahr., and that at above 170 deg. fahr. danger lies in the possibility of excessive oil temperatures which may reduce the viscosity of the oil below the recommended 60 sec. S.U., thereby causing damage to the engine.

Mr. Templin showed the need for crankcase oil temperature control for both low and high operating temperatures. Such control, he said, would effect definite economies in operation, especially by permitting lighter oils to be used safely, which would allow satisfactory starting and prevent low temperature cylinder corrosion. Lower maximum temperatures of circulating oil would have a definite influence in lowering the internal temperatures of the engine, especially of the pistons and bearings, he stated, adding that the life of these and related parts would be prolonged. Another factor in reducing engine wear, he declared, is the avoidance of film rupture and oil decomposition by operating with lighter oils at a controlled maximum temperature.

Many creditable efforts have been made, he said, to provide

To the Champion Goes the Cup

With the SAE Golf Trophy in hand is J. H. McDuffee, winner of this year's tournament. At the left is Golf Committee Chairman Robert F. Steeneck, who made the presentation. Col. J. G. Vincent and H. H. Knepper look on. Mr. Knepper is holding the prize which also went to Mr. McDuffee.

On the first tee George Sevald takes movies which will show Mr. Steenbeck, with cap, M. H. Alldredge, Jr., P. D. Hileman and G. H. Hufferd.

crankcase oil temperature control units. However, he continued, a complete mechanism for control of both high and low temperatures should be designed especially for, and built into the engine so that the full benefit of oil temperature control possibilities may be realized.

Until engine designers provide adequate crankcase oil temperature control, he declared, operators may well protect their engines against excessive temperatures by use of crankcase oil temperature indicators.

Mr. Templin showed, from the data presented, that by the use of engines with adequate temperature control it would be possible to use SAE 20 or 30 oil almost universally, year in year out, with a reduction in engine wear and improvement in performance.

Several discussers seriously questioned Mr. Templin's assumption of 60 sec. S.U. as a minimum viscosity – or of any given viscosity as a minimum for that matter. The interrelationship of the qualities of oiliness and viscosity was emphasized as one factor making it difficult, if not impossible, to set a minimum viscosity figure.

G. L. Neely, Standard Oil Co. of Calif., pointed out that the introduction of the full-length water jacket prevents excessive temperature of crankcase oil, and is a step in the right direction. The principal problem, he believes, is the development of suitable means of preventing the extremely low temperatures that interfere with cranking. Electric heating devices, he added, are a good substitute for a heated garage, but are of no use in a parking lot or on a street where there is no electric socket to plug into.

Edward F. Donham, Illinois Bell Telephone Co., has noticed that sludging occurs during cold months due to cooler operating temperatures of present-day engines, and suggested warming of crankcase oil might help avoid this.

That temperature control of crankcase lubricants is needed to avoid rapid oxidation leading to ultimate destruction of the lubricant, was the opinion of A. W. Burwell, Alox Corp.

Other discussion submitted by A. Ludlow Clayden, Sun Oil Co.; Max M. Roensch, Chrysler Corp.; H. C. Mougey, General Motors; Carl T. Doman, Doman-Marks Engine Co.; Weldon Worth, U. S. Army Air Corps; F. M. Young, Young Radiator Co.; Gordon McIntyre, Imperial Oil, Ltd.; W. J. Cumming, Surface Transportation Corp. of New York; L. P. Saunders, Harrison Radiator Co.; and Dr. Ulric B. Bray, Union Oil Co. of Calif., added to the foregoing remarks.

Gadgets Get Explained at Fuels and Lubricants Session

A. G. Marshall, Shell Oil Co., came from the Pacific Coast to preside at the Gadgets Session, Friday morning, which was sponsored by the Fuels and Lubricants Activity. Six short papers were read on instruments recently devised for knock rating of fuels, to indicate spark advance, for automatic speed-

load dynamometer control, and to study valve gear and crankshaft vibration.

The first instrument described was a springless bouncing-pin indicator. The paper was read by Earl Bartholomew of Ethyl Gasoline Corp., who collaborated with Cleveland Walcutt, also of Ethyl, in its preparation. Comparing the instrument to the bouncing pin indicator employing a piston whose movement is resisted by a heavy coil spring and a later device where the piston and spring are replaced by a thin diaphragm, he listed the advantages of the springless indicator having the pin actuated by both a diaphragm and the engine cylinder as: elimination of a secondary bounce of a pin which reduces the number of electrical contacts per explosion; improved electrical contact; long life of contact points; high degree of stability in operation; maximum sensitivity, easily obtained by the adjustment of the gap between the contact points; ease of adjustment.

The Sunbury Knock Indicator was described in a paper by Richard Stansfield and E. S. L. Beale, Anglo-Iranian Oil Co., which was read by J. R. Sabina, Atlantic Refining Co. Briefly, this device records the velocity at which the cylinder is strained, as an indication of the intensity of knock, by an iron rod fixed to the upper part of the cylinder and by mounting an electromagnetic type of pick-up unit on the water connection at the lower end of the casting; the lower end of the rod and the pole at the pick-up being adjusted to give an air gap of a few thousandths of an inch. The pick-up unit, it was explained, consists of a permanent magnet around the pole of which is wound a coil of fine wire connected to the terminals from which the electrical output may be taken, this output being proportional to the velocity at which the air gap alters. Loads are carried from the unit to the grid of the rectifying and amplifying vacuum tube and thence to the knock meter. The reading on the meter can be arranged to vary with knock intensity. The authors noted particularly that this device has no moving parts other than the pointer of the knock meter.

At this point Prof. P. H. Schweitzer of Pennsylvania State College discussed the Penn State Ignition Lag Indicator for rating Diesel fuels and gave a brief demonstration in explaining its use. In this instrument the compression ratio is shifted until a fixed time lag of 15 deg. occurs, rather than by using a definite compression ratio to determine time lag.

Two methods of determining spark advance under actual road conditions were explained by Gilbert Way, Chrysler Corp., and J. R. MacGregor, Standard Oil Co. of Calif. Mr. Way read a paper which he prepared in collaboration with Sidney Oldberg and J. B. Macauley, Jr., also of Chrysler, describing the methods used by their company. The device used by the Standard Oil Co. of Calif. was explained by Mr. MacGregor, who collaborated with K. R. Eldredge, of the same company, in the preparation of the paper.

Mr. MacGregor also read a paper, which he and L. T. Folsom, also of Standard Oil, prepared, on Automatic Speed-Load Dynamometer Control. In it was described an electric circuit conceived and developed by Mr. Folsom, to be used with an electric generator which, under actual tests, has given results showing it to be flexible to a degree where it is able to approximate in the laboratory any set of conditions likely to be encountered on the road.

The final paper on the symposium was prepared by Sidney Oldberg, Maynard Yeasting and Max M. Roensch, all of Chrysler, on "Valve Gear and Crankshaft Vibration Studies With Cathode Ray Oscillograph." Read by Mr. Roensch, it pointed out that the cathode ray oscillograph is particularly adaptable to study the general problem of engine smoothness because of its attendant advantages in unlimited frequency response, convenience of use, ability to synchronize to a recurrent pattern, and large viewing screen.

The authors described an instrument developed to include the features necessary to cover the broad range of problems existent or contemplated, using as illustrations of its application studies of valve gears and crankshafts.

The nature of the papers limited the discussion. It was brought out that in instrumentation electronic devices are more and more coming into use and that it is particularly important that there is no distortion developed by the electronic devices themselves giving false indications of the phenomena to be measured.

Written discussion prepared by L. C. Roess, the Texas Co., describing action of the bouncing pin as observed in a study using a cathode ray oscillograph to record the number and length of contacts, was read by Mr. MacCoull. One result of this study, he said, was to show that multiple contacts per explosion are due to what may be termed "spring surges," and not to multiple bounces of the pin itself.

T. B. Rendel, Shell Petroleum Corp., commented that the Sunbury indicator has the distinct advantage of also being capable of measuring Diesel fuels for cetane numbers.

Dr. A. E. Becker, Standard Oil Development Co., remarked that although the Sunbury indicator does not take care of all difficulties it is another step in advance. He also noted that the Sunbury indicator can be set in the morning for use during an entire day and that this cannot be done with the bouncing-pin indicator. Neil MacCoull, Texas Co., particularly complimented the paper read by Mr. Way on the spark-advance indicator, for its frank presentation of data showing ratings of specific cars using distinct fuels. This, he believes, is the first time that such data has been revealed by a motor car manufacturer.

Mr. MacCoull also expressed his belief that the dynamometer described by Mr. MacGregor and Mr. Folsom has far more flexibility than the ordinary chassis dynamometer. He also mentioned the necessity, in making dynamometer tests, of having plenty of air driven over the car to cool the oil pan under the engine as well as the radiator. This was also borne out by L. P. Saunders, Harrison Radiator Co.

New "Oiliness" Data Stir Wide Discussion

General agreement on just what "oiliness" is, appeared definitely nearer after surprising new data on its effects and relationships had been presented at the Lubricants Session directed by C. Herbert Baxley, International Aviation Associates, session chairman. Both of the papers given – the first reporting oiliness and wear investigations on a new testing machine, and the second studying oiliness as related to high-pressure viscosity – were widely discussed.

"Friction and wear do not correlate, and high oiliness does not necessarily result in low wear," was the startling conclusion of the paper: "High Oiliness – Low Wear?" by G. L. Neely, Standard Oil Co. of Calif., which presented the results of investigations on his newly developed "Kinetic Oiliness Testing Machine."

This machine, Mr. Neely explained, was designed to minimize the effects of viscosity in order to investigate lubricants under conditions where oiliness effects predominate. Another important feature of the machine, he continued, is that the surfaces are maintained automatically at a fairly uniform degree of smoothness by the lapping action produced by the combined rotating and sliding motion of three bronze pivoted buttons as they are driven around a circular steel track. Test oil is supplied to the track through tubing, he went on, and the steel track showed no measurable wear in these tests, whereas the wear of the bronze buttons was of sufficient mag-

nitude to be measured by weighing the buttons before and after each test.

Tests on lubricants employing various addition agents show, Mr. Neely concluded, that it is a simple matter to find an addition which merely improves oiliness, but its effectiveness on the wear-reducing value of the lubricant may be considerably different in degree, and sometimes in direction, from the effect on friction.

The rule of "ladies first" was applied by Chairman Baxley in the discussion of Mr. Neely's paper, with Miss Louise Leidig, National Bureau of Standards, leading off. She pointed

(*Continued on page* 39)

Around the Casino and on the Golf Course

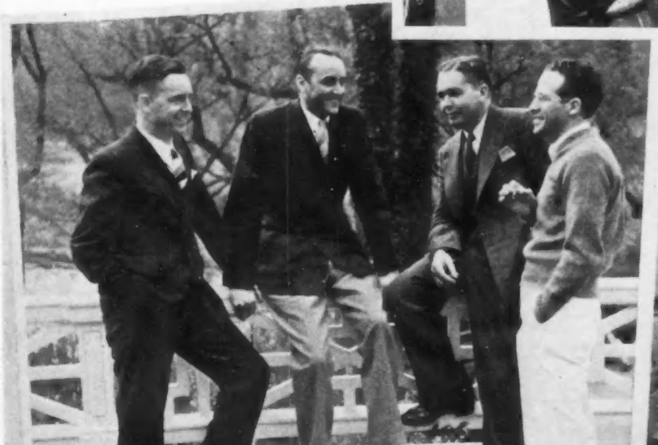
Above, D. D. Robertson, Gordon Brown and B. B. Bachman

Above, Clayton Farris, E. D. Sirrine, J. L. Carson and Herbert Happersberg

Right, William Fairhurst and Roy E. Cole

Below, E. W. Higgins, Schuyler Hazard, Jr., J. H. Booth and W. I. Ford

Below, Clinton Rector, D. E. Gamble, W. C. Munson, L. J. Loranger and G. P. Hall



About SAE Members:

Burgess Darrow, development manager, Goodyear Tire & Rubber Co., Akron, has been transferred to California as manager of technical service. Mr. Darrow has been affiliated with Goodyear since graduating from M. I. T. in 1911 and was previously connected with the California plant from 1920 to 1923.

L. B. Alliason has joined the staff of National Broach and Machine Co. as sales engineer. He was formerly engineering representative in Detroit for Fellows Gear Shaper Co.

J. S. Shelton, former warrant officer, aeronautical engineering, U. S. Coast Guard, Miami, Fla., has joined the Glenn L. Martin Co., Baltimore, as aeronautical engineer.

Thomas M. Nevin has been appointed Studebaker district manager for Mexico, Central America and the Caribbean, with headquarters in Mexico City. Mr. Nevin has been associated with Stewart Warner, Budd Wheel and Rockwell Products. He resigned his position as general sales manager of the latter company to accept the Studebaker appointment.

Thomas M. Nevin
To Mexico City

George Mueller, Jr., formerly in the engineering department of the LeBlond-Schacht Truck Co., Cincinnati, has been made sales engineer.

Frank M. Smith has been made vice-president and general manager of the Stout Engineering Laboratories and the Stout Motor Car Corp. He will be located in Dearborn.

Walter F. Whiteman has joined the B. & J. Auto Spring Co., Brooklyn, N. Y. He was formerly spring service engineer with Brodie System, Inc., also in Brooklyn.

W. H. Blackmer is vice-president and general manager of the Packless Metal Products Corp., Long Island City, N. Y. He was previously with the Laminated Shim Co., Inc., of the same city, as sales manager.

J. W. Shields, who was in the truck and bus tire department of Firestone Tire & Rubber Co., Akron, has joined U. S. Rubber Products, Inc., as sales engineer. He will have headquarters in Detroit.

Laurie C. Smith has severed his connection with the Atlas Imperial Diesel Engine Co., Oakland, Calif., and is now employed by the Pacific Gas and Electric Co., San Francisco.

L. R. Jones has resigned his position as chief engineer with the Auburn Automobile Co., Connersville, Ind.

P. W. Litchfield, president of the Goodyear Tire & Rubber Co., sailed from New York on S.S. Washington, May 4.

Major M. V. Brunson, Quartermaster Corps, U. S. Army, was designated an honor student in civil engineering, graduate school, at the Honors Convocation of the University of Michigan.

Arthur Nutt, vice-president in charge of engineering, Wright Aeronautical Corp., has been appointed by the Council to succeed E. P. Warner, whose term expires, as SAE representative on the Engineering and Industrial division of the National Research Council. Carl Breer, Chrysler Corp., the Society's senior representative, will continue to serve.

W. H. Higham of the Vacuum Oil Co. of South Africa, Ltd., Cape Town, S. A., visited the Summer Meeting of the Society during his first trip to the United States in five years.

R. Masson Webster, Jr., is chassis and tool designer with the American Bantam Car Co., Butler, Pa. He was previously layout draftsman with the Mack Manufacturing Corp., Allentown, Pa.

Com. Bruce G. Leighton, recently made vice-president of the Intercontinent Corp., New York, will have headquarters in Shanghai, China.

S. G. Nordlinger has joined the Shell Petroleum Corp., as senior mechanical engineer, Wood River, Ill.

J. P. Hilands is vice-president of the Pipe and Tube Bending Corp. of America, Newark, N. J. He was formerly affiliated with the Tube Reducing Corp., Stamford, Conn.

Edsel Ford is the new owner of Pierre Renoir's noted painting "La Tasse de Chocolat." Painted in 1878, this picture has long been considered one of the French master's most distinguished figure subjects.

C. T. S. Capel, formerly engineering superintendent, South African Airways, Durban, Natal, S. A., has taken the position as chief engineer of British Airways, Ltd., Gatwick Airport, Horley, Surrey, England.

Ralph S. Jenkins has been named vice-president of Gar Wood Industries, Inc., Detroit. He will be in charge of manufacturing in all of its divisions. Mr. Jenkins came to Gar Wood from the St. Paul Hydraulic Hoist Co., where he was general manager.

Frank E. Watts has been promoted to vice-president of the Hupp Motor Car Corp. Mr. Watts has been active in the industry for more than 30 years. Back in 1904 he was designer for the Electric Vehicle Co. and the Eisenhuth Horseless Vehicle Co., and was also technical writer for the *Horseless Age* magazine. He joined Hupp in 1910 as designer and engineer. He was made chief engineer in 1916, a post he has held continuously since that time.

Frank E. Watts
Hupp
Vice-President

H. M. Jacklin's title recently has been changed from associate professor to that of professor of mechanical engineering. He is on the faculty of Purdue University, West Lafayette, Ind.

E. T. Vincent, who has been chief engineer, Diesel division, Continental Motors Corp., has joined the faculty of the University of Michigan as professor of mechanical engineering. He is retained in a consultant capacity by Continental.

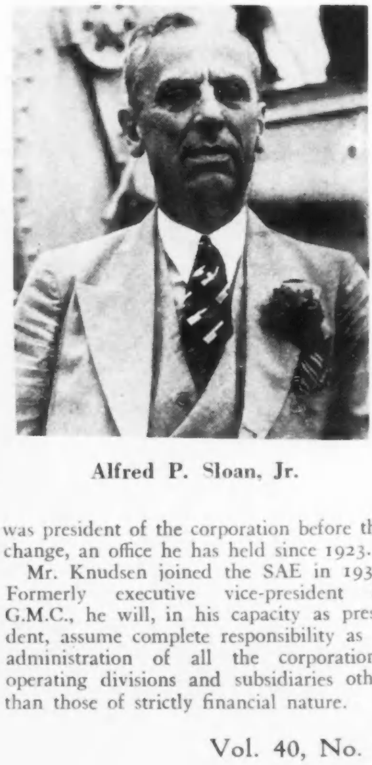
Dr. Henry Edward Merritt is assistant superintendent of design, Royal Arsenal, Woolich, London, England.

Executive Changes at General Motors

Alfred P. Sloan, Jr., has been elected chairman of the Board of General Motors Corp., and William S. Knudsen, president. Mr. Sloan will also be chairman of the newly established Policy Committee which will have jurisdiction on questions of broad corporation policy, involving both finance and operation. Mr. Knudsen is a member of this committee and another SAE member serving on it is C. E. Wilson.

Mr. Sloan, a member of the society since 1910, was president of the corporation before this change, an office he has held since 1923.

William S. Knudsen



Alfred P. Sloan, Jr.

Mr. Knudsen joined the SAE in 1934. Formerly executive vice-president of G.M.C., he will, in his capacity as president, assume complete responsibility as to administration of all the corporation's operating divisions and subsidiaries other than those of strictly financial nature.

. . . . At Home and Abroad

Frank P. Gilligan, secretary and treasurer, Henry Souther Engineering Co., chairman of the Iron and Steel division of the SAE Standards Committee, has been appointed to represent the Society on the American Society for Testing Materials Committee E-1 on methods of testing, section on tension testing. He replaces J. B. Johnson, Materiel Division, U. S. Army Air Corps, who resigned because of pressure from other work. A. L. Boegehold, General Motors Research Corp., has been appointed Mr. Gilligan's alternate.

J. E. Batchelor has joined the staff of the Ethyl Export Co., following his resignation from the Vacuum Oil Co. Pty., Ltd., where he has been employed as automotive engineer and aviation officer for Queensland, Australia. In his new position he will be located in Melbourne, Australia.

F. J. Foster is on the engineering and experimental staff of the American Bantam Car Co., Butler, Pa.

Leonard Doppel has joined the Circle Cab Corp., New York taxicab operators, as engineer. He was previously engineer with the Eagle Cab Corp., also in New York.

Harry M. Whittaker was named chief engineer of the Micromatic Hone Corp., Detroit, on May 1. He formerly was associated with the

Harry M. Whittaker
New Affiliation

Ex-Cell-O Aircraft & Tool Corp., and until recently was head of the Whittaker Engineering Co. of Detroit.

Delmar G. Roos, technical adviser, Studebaker Corp., has recently returned to the United States from Europe where he has been studying automotive developments. While abroad he also served as consultant to Rootes Securities of London, who control Humber, Hillman, Talbot, Sunbeam and Commer.

Active on A.T.A. Committees

Fourteen members of the SAE are among those appointed to five new subcommittees of the American Transport Association's Bus Division's committee on development of equipment of which J. C. Baine, Jr., is chairman.

Serving with E. S. Pardoe, chairman of the subcommittee on passenger convenience and comfort, are D. E. Blair, H. E. Simi and H. I. Sullivan. On the Diesel engine subcommittee, of which Mr. Blair is chairman, are W. J. Cumming, A. J. Scaife, Martin Schreiber, Mr. Simi, R. C. Snell, Mr. Sullivan and Guy W. Wilson.

With R. H. Stier, chairman of the fuel and fuel supply subcommittee, are Charles Guernsey, Mr. Pardoe, Mr. Scaife, S. B. Shaw and Mr. Simi. Mr. Simi is chairman of the technical review subcommittee. SAE members serving with him are Mr. Guernsey, Mr. Scaife, Mr. Shaw, Mr. Snell, Mr. Stier and Mr. Wilson.

Working with Mr. Guernsey, chairman of the ventilation, heating and elimination of bus odors subcommittee, are Mr. Baine, Mr. Cumming, Mr. Pardoe, Mr. Schreiber, Mr. Snell, Mr. Sullivan, F. L. Wheaton and Mr. Wilson.

Frederick Ritz has been elected vice-president of the Hooven, Owens, Rentschler Co., in charge of Diesel engine manufacturing. Mr. Ritz was formerly superintendent of the Diesel department, General Machinery Corp., of which Hooven, Owens, Rentschler Co. is a subsidiary.

John A. Watts has joined the Hartford Accident & Indemnity Co., Chicago, as engineer in the special risk and engineering department. He was previously on the engineering staff of Hoof Products Co., also Chicago.

Leslie Peat, former editor of *Automotive Industries* and recently connected with *American Machinist* and *Business Week,* has been named New York editorial representative of *Automotive Industries.*

Duncan P. Forbes, president and general manager, Gunite Foundries Corp., Rockford, Ill., has been elected a director of the American Foundrymen's Association for a three-year period.

Dr. Zay Jeffries, technical director, incandescent lamp department, General Electric Co., spoke on "Metallic Vitamins" before the Mid-Atlantic Sectional Meeting of the American Society for Metals, New York, May 14.

E. A. Cousins has joined W.G.B. Oil Clarifier, Inc., Kingston, N. Y., as manager, manufacturers' sales, with headquarters in Detroit. He was formerly boxing engineer, Chrysler Corp.

Arthur N. Lappin has joined the engineering staff of Sikorsky Aircraft division of United Aircraft Manufacturing Corp., Stratford, Conn. He was previously junior engineer with the National Advisory Committee for Aeronautics, Hampton, Va.

Charles A. Lindemann, formerly mechanical designer, Philco Radio & Television Co., Philadelphia, has joined the General Electric Co., Bridgeport, as design engineer.

This signature of *Ernest Wooler,* chief engineer, Timken Roller Bearing Co., found its way to Ripley's "Believe It or Not" cartoon. Besides having a unique signature, Mr. Wooler is vice-chairman of the ball and roller bearing division of the SAE Standards Committee. At the Summer Meeting, just past, he presided at the Hypoid Gear Session.

Victor W. Pagé is author of the recently published 700-page book, "The Ford V-8 Cars and Trucks." In it he covers their construction, operation and repair.

R. R. Whittingham has resigned as assistant division manager, Gulf Oil Corp., in New York, to accept the position of eastern sales manager, New York Lubricating Oil Co., New York.

Robert I. Dick has been appointed assistant chief engineer, Valley Iron Works, Appleton, Wis. He was formerly in the engineering department of Fairbanks, Morse & Co., Beloit, Wis.

Harry E. Schweigler is on the engineering staff of the Glenn L. Martin Co., Baltimore. He was previously in the engineering department of Beech Aircraft Co., Wichita, Kan.

G. Waine Thomas has been appointed chief engineer of the Reo Motor Car Co., Lansing. This promotion follows ten years of experi-

G. Waine Thomas
Reo Chief Engineer

ence with Reo in truck and bus engineering capacities. He was formerly with Service and Indiana Motor Truck Cos.; the U. S. Ordnance; the Apperson Co.; and was chief engineer for the Duplex Truck Co., where he designed searchlight units for the Japanese Army. With Reo he supervised the design and construction of the first Reo pusher bus.

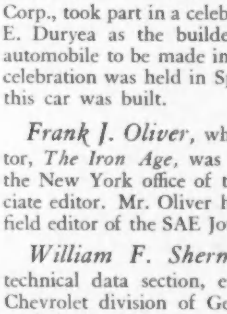
K. T. Keller, president of the Chrysler Corp., and *Charles F. Kettering,* General Motors vice-president in charge of research, were among the speakers at the Midwest conference on Occupational Diseases in Detroit during the first week of May.

Julian Chase, directing editor, Chilton Publications, and *David Beecroft,* Bendix Products Corp., took part in a celebration honoring Charles E. Duryea as the builder of the first gasoline automobile to be made in the United States. The celebration was held in Springfield, Mass., where this car was built.

Frank J. Oliver, who has been Detroit editor, *The Iron Age,* was recently transferred to the New York office of that publication as associate editor. Mr. Oliver has been Detroit Section field editor of the SAE JOURNAL for the past year.

William F. Sherman, formerly in the technical data section, engineering department, Chevrolet division of General Motors, has succeeded Mr. Oliver as Detroit editor, *The Iron Age.*

H. O. K. Meister has been appointed general manager of the Hyatt Bearings Division of



H. O. K. Meister
G. M. of Hyatt

G.M.C., Harrison, N. J. He has been affiliated with Hyatt since 1914. In 1929, he was named assistant general manager in which capacity he was serving at the time of his recent promotion.

News of the Society

Cut-Throat Competition Seen Barrier to Safety

• Northwest

Safe operation and wildcat competition don't mix, said H. C. Reynolds, Interstate Commerce Commission, Seattle territory, in speaking before the April 16 meeting of the Northwest Section. He pointed out that in the operation of common carrier trucks, chiseled rates and other forms of unfair competition bring experienced and inexperienced operators alike to a point where they cannot afford to use equipment of sufficient size; where they overload; run their vehicles at high speeds; and operate their trucks with poor lights, inadequate brakes and worn out tires.

The speaker stated that there is every evidence that Congress, in enacting the Motor Carrier Act, recognized that regulation of rates, keeping of good records, provision of insurance, and general consideration of the public's convenience and necessity in authorizing new operations are valuable, if not essential, in bringing about greater safety.

Mr. Reynolds noted that in the Motor Carrier Act the only direct statement relating to the powers and duties of the Commission with respect to safety (Sec. 204) provides that it shall be the duty of the Commission to establish reasonable requirements with respect to qualifications and maximum hours of service of employes and safety of operation of equipment. In this respect he also pointed out that, although exempt from other conditions of the Act, taxicabs, hotel buses, school buses, agricultural carriers and other exempt vehicles, are made subject to any safety requirements the Commission may see fit to impose upon them. Thus, he said, its powers are much more extensive in matters of safety than in any other phases of regulation.

Safety regulations, he said, have advanced further in some parts of the country than others. Varying regulations between states, he pointed out, have made for considerable friction between the states, and court decisions have denied the states the rights to apply many phases of their regulations to interstate carriers. As a result some interstate carriers have engaged in unbridled competition – "thumbing their noses at each other and at state regulatory bodies," he added.

Mr. Reynolds blamed the trucking industry itself for some of the restrictive legislation that has been passed by state bodies. Even presupposing that competing industries have done some vote buying, log rolling and indulged in graft, the public itself has been willing, even desirous, to see the motor carriers punished by legislation, he declared. The reason for this, he added, is that the public, rightly or wrongly, looks upon the motor carrier as a menace to safety on the highway; and that viewpoint is based upon the public's contact with these vehicles.

Lacy V. Murrow, director of the department of state highways, State of Washington, followed Mr. Reynolds on the program. He spoke of the new highway code in operation in Washington, explaining that it had been drafted so that the regulations would be reasonably easy to understand and reasonably easy to enforce. The National Safety Council and the Safety Section, Bureau of Motor Carriers, Interstate Commerce Commission, he reported, contributed their help. Continuing, Mr. Murrow discussed sections of the code which he believed would be of most interest to those attending the meeting.

Stryker Again Chairman Of Aircraft Meeting

Plans are going ahead for the SAE National Aircraft Production Meeting to be held in Los Angeles, Oct. 7-9. At its last meeting the Council affirmed the appointment of Carleton E. Stryker, chief engineer, Curtiss-Wright Technical Institute, as general chairman of the meeting. It was with Mr. Stryker in this capacity that the first National Aircraft Production Meeting, held last year, was so successful.

Mr. Stryker and his local committee will work in close cooperation with SAE Vice-Presidents A. L. Beall, representing aircraft-engine engineering, and F. E. Weick, representing aircraft engineering, and with the two professional aircraft committees.

Diesel Costs Down Tenfold Since War

• Pittsburgh

"A Diesel engine would cost you $100 per horsepower at the end of the War, but one can now be had for about $10 per horsepower," estimated O. D. Treiber, Hercules Motors Corp., to illustrate the tremendous strides in Diesel development made in that period while speaking before an excellent turnout of 220 at the Pittsburgh Section Meeting, April 20. Mr. Treiber was introduced by Stephen Johnson, Jr., session chairman, and spoke on the fundamentals of Diesel engineering design, application, and service.

He went on to tell of the problems that had to be solved in the development of smaller, faster, and lighter engines for automotive use. These problems were made still harder, he pointed out, by the necessity of designing Diesel engines for chassis designed to accommodate gasoline engines and by the need to meet the competitive price of gasoline engines, and to be of comparative size, weight, speed and mean effective pressure.

One of the important problems encountered in attempting to increase speeds, Mr. Treiber explained, is that of burning the fuel fast enough to keep pace with the rapidly moving pistons. Unlike the gasoline engine where the fuel and air are mixed largely in the carburetor and manifolds, in the Diesel engine, he continued, the mixture of fuel and air must be accomplished completely in the combustion space and in a more limited time.

Discussing compression ratios, Mr. Treiber told of how loss of efficiency begins at a 10:1 compression ratio on a strictly thermodynamic basis, but compression ratios up to 18:1 are used in Diesel engines for easier starting and better ignition of fuel, he explained. Twice the miles per gallon is obtained provided that the critical point in the fuel combustion curve is not exceeded, Mr. Treiber pointed out, continuing his comparison of gasoline and Diesel engines. Diesel engines are more efficient when developing slightly less than maximum power, and this high efficiency is maintained through a wide range of engine speed and power, he added.

Speaking on the lubrication of Diesel engines, Mr. Treiber indicated a trend toward thinner oils in order to secure adequate lubrication between closely fitted parts. He explained the use of the viscosimeter and predicted that, since it gives a more important indication of oil condition, this device probably will supersede oil-pressure gages.

"Little is known with certainty about the lowest possible limit of Diesel fuel oil viscosity," replied Mr. Treiber to his first discusser, Louis A. Calkins, Valvoline Oil Co., "but, in fuels of less than 35 sec. Saybolt Universal at 100 deg. fahr., there is very little lubricant," he continued, "so that, when kerosene which has a viscosity of about 32 to 33 sec. is used as fuel, we put in 1 qt. of lubricating oil in each 5 gal. of kerosene.

Others discussing Mr. Treiber's paper included Prof. Sumner B. Ely, Carnegie Institute of Technology, and Ralph Baggaley, Jr., McCrady-Rodgers Co.

Textile Makers Oust Inhibitions, Says Bird

• Detroit

Mystifying inhibitions and traditions have been pushed aside by the textile industry to make room for scientific control and management, largely as the result of demands of the automotive industry, said W. F. Bird, director of research and technical control, Collins and Aikman Corp., before the Detroit Section's April 12 meeting. He was introduced by Frank S. Spring, Section vice-chairman of body activities. Some years ago, Mr. Bird continued, it was not uncommon for textile manufacturers to make a fabric a good deal like the old-fashioned housewife made a cake; namely, by inspiration – and sometimes it turned out good and sometimes not.

Stating that textile manufacturers have to work with raw materials that are to a large extent natural products not wholly controllable by man, he declared: "We refuse to admit to ourselves that this condition influences our subsequent manufacturing results to such an extent that we cannot predict or control them . . . . we know that if we are smart enough we can control these things so that our resulting products may be standardized to a very high degree."

Mr. Bird listed three basic principles in establishing quality control. The first is to get rid of all "prima donnas and grand-stand players" and to substitute intelligent, progressive and cooperative production management. The second is to establish manufacturing specifications and the third, rigid inspection.

Speaking of dyeing materials he said there are, in general, three different methods. Noting that each of these has distinct advantages for certain ultimate uses, he discussed them only from the standpoint of the dyeing of automobile upholstery material, as follows:

1. Stock Dyeing: Stock dyeing consists of dyeing the raw material before it has been processed into yarn. For automobile upholstery dyeing its advantages are very questionable.
2. Yarn Dyeing: In this method the yarns are dyed the required color before they are woven into a fabric. For the automobile upholstery business, where the requirements are all-over

solid shades, or patterns of a subdued nature, this method is not practical.

3. Piece Dyeing: In this method of dyeing the material is woven into a fabric in its natural state and then dyed. The advantages of piece dyeing for automobile upholstery fabrics are: ease of control and flexibility in control of production quantities and inventories. Because of these points piece dyeing is the accepted method of dyeing automobile upholstery pile fabrics.

Mr. Bird listed requirements for automotive fabrics as: long life and ability to take hard wear; maximum style and beauty for luxurious and smart trim effects; ease of handling; elasticity and softness for comfort; ventilation for dissipation of body and interior heat; maximum resistance to spotting and ravages of accumulated road dust and dirt.

After research had established that, in general, velvet construction was correct for automotive uses, he said, it became necessary to invent a new fabric, because those in production did not completely meet the specifications set up. A program was launched, he explained, which resulted eventually in a mohair velvet with shorter, firmer, softer pile; with fibers anchored individually and ventilated so air would pass freely through it to dissipate body heat. This also prevented "air binding" which causes a tendency to bumpy riding, he added. Motion pictures illustrated the manufacture of the new fabric.

Vincent P. Rumely, Detroit chairman who has recently moved to Chicago, with the Crane Co., returned to Detroit to preside at the session.

211 Hear Thrills of Stratosphere Ascents

• Chicago

The adventurous and danger-fraught aspects of balloon flights into the stratosphere and the scientific value of the data acquired, were depicted before 211 members and guests of the Chicago Section at its April 30 meeting, by Maj. Chester L. Fordney, commanding officer, Central Reserve Area, U. S. Marines.

A highly instructive feature preceding the dinner and formal program, held at the 108th Observation Squadron Hangar, Chicago Municipal Airport, was an inspection trip of airline equipment and airport facilities under the guidance of representatives of the American Airlines and the United Air Lines. This inspection included exhibits of the American Airlines, United Air Lines and a Military Aviation exhibit staged in the 108th Observation Squadron Hangar. While inclement weather in the afternoon somewhat limited the attendance on the inspection trip, it failed to dampen the enthusiasm of the visitors which included many aviation students and sons of SAE members.

Describing the Navy's record-breaking stratosphere flight from Akron, Ohio, in which he participated as an observer, Major Fordney revealed the exacting methods employed in acquiring meteorological data in the 10-mile-up zone from an enclosed metal gondola, and the value of such data for future air travelers. Screen slides of the flight were shown by Major Fordney, together with a display of the altimeter and other instruments of measurement which were used on the flight.

Major McElvaine of the 108th Observation Squadron, host for the Section, spoke briefly on the needs for airplane equipment and facilities for the squadron, and Captain Newhall directed a demonstration of message transmission by radio to and from planes in flight above the airport.

The highlights of present-day modern air transport-plane developments were discussed by William Littlewood, vice-president in charge of engineering, American Airlines, Inc., who shared the program with Major Fordney. Reviewing the step-by-step progress in design improvements of wing structures, fuselage, propellers, tail structures, brakes, and landing wheels, Mr. Littlewood gave his listeners a clean-cut presentation of the remarkable strides with which airline transports have advanced to new standards of airplane engineering and performance. The improvement in propeller design from the early wooden types to the latest constant-speed type, he stressed, as representing one of the greatest single contributions in man's conquest of the air.

Edward A. Sipp, as chairman of the technical session, introduced the speakers.

Erratum

An important footnote was omitted from the bottom of Fig. 1 – Ocean Transports – Comparative Data, of "Ocean Air Transportation," by L. C. McCarty, published on pp. 14 and 15 of the May, 1937, issue of the JOURNAL. This footnote explains the asterisks preceding figures for the "Range to dry tanks" (Item No. 27) for the A and B models as follows: "*Range to dry tanks is 4000 miles against a 35 m.p.h. head wind plus 4 hr. reserve."

Winners in Student Paper Contest

Photo by Leslie Peat

• Metropolitan Section Chairman T. C. Smith with winners of Met Section's Student Paper Contest. *From left:* Walter E. Arnoldi, awarded first prize of $50 for his paper, "The Nitric Oxide in Exhaust Gases of Internal Combustion Engines"; Mr. Smith; Second Prize Winner Stephen M. Batori and Third Prize Winner Igor Kamlookhine. These students attend Stevens Institute of Technology.

Credits Fuel Research In Aircraft Engine Talk

• Philadelphia

The engine manufacturer's responsibility does not end with a well-designed engine, maintained Raymond W. Young of the Wright Aeronautical Corp., in his paper before the Philadelphia Section at its May meeting. Airworthiness of the whole ship, he continued, is a problem of the engine manufacturer as well as the ship designer, hence installation and control of the engine have occupied much of the engine maker's time in recent years. Engine mounting, he added, has been a particularly difficult problem and cowl design has much to do with the engine cooling, and consequently, performance.

Outlining the main steps that have made possible almost doubling engine horsepower output without materially increasing engine size, Mr. Young stated that fuel research has made possible many features of engine design that have contributed to both greater power output and reliability. He also noted that lubricants and lubricating systems have had much to do with ability and dependability.

Mr. Young made no definite prediction relative to the Diesel engine's place in aircraft but he pointed out that the Germans have been fairly successful with the Diesel engine in several of their craft where long range work with economy was desired.

Correct Road Position Declared Safety Factor

• Metropolitan

Too often neglected as a major factor in highway safety, is the careful observance of the relative position of vehicles, according to J. Willard Lord, motor transport engineer, Atlantic Refining Co., who addressed the closing session of the Metropolitan Section's 1936-37 season Monday evening, May 17. His paper, illustrated with a series of slides showing where vehicles were in relation to each other at the time of accidents, was concurred in by the majority of automotive engineers and transportation experts who attended the meeting.

Too much reliance, he said, has been placed on hand signals, stop lights and directional devices. Merrill C. Horine, Mack Mfg. Corp., agreed, and suggested that an appeal to sportsmanship of drivers would be more effective than an appeal to courtesy. The latter virtue, he contended, is practically extinct in this nation.

The Society has the all-important function of providing the technical advice needed in any highway safety program, Sydney G. Tilden told the meeting. Far too many regulations, which have no basis in engineering knowledge, are imposed by municipal and state officials with the result that they become obsolete because of new designs or are contrary to regulations in neighboring towns and states.

The Session was held under the joint sponsorship of the research and safety and the student activity. Prizes were awarded to winners of the Section's Student Paper Contest, pictured above. Austin M. Wolf presided.

Over two hundred members and guests turned out for the Metropolitan Section Party April 22. After dining at the Paradise Night Club some attended Major Bowes' broadcast and others witnessed the air-presentation of the Show Boat program.

Parts *Must* Be Perfect Says Airline Engineer

• New England

What in other forms of transportation might be an annoying delay, would, in aviation, be a fatality, declared C. M. Belinn, superintendent of engineering, National Airways, Inc., in stressing, to members and guests at the May 11 meeting of the New England Section, that, unlike other forms of transportation, the airplane depends *solely* upon the perfection of its parts to sustain flight. With him on the program was S. Paul Johnston, editor of *Aviation,* who told of his recent visit to European aviation centers.

Both speakers were introduced by Prof. C. F. Taylor, chairman of the session.

Recalling that not many years ago aviation was a rich man's toy, Mr. Belinn gave credit to another type of man who through foresight, intelligence and hard work linked both coasts with an air transport system in the late '20s. At that time, he said, equipment was expensive and failures frequent because manufacturers had not realized that an imperfect part was useless and dangerous. As a result, he added, the operator had to spend huge sums to make equipment flyable after delivery.

Soon, he continued, both operator and manufacturer concluded that, aside from the elements, dependability could be no better than the equipment and its maintenance. It was also at this time that instruments were begun to be taken seriously, he added, and noted that from a set up consisting of an oil-pressure gage, tachometer, compass and ignition switch the modern instrument panel was developed.

Mr. Belinn then gave some interesting comparative figures. "An engine of a basic type," he said, "was produced in 1930. During its first year of operation failures were frequent under 250 hr. It required 200 man-hours to overhaul, used 1½ qt. of oil per hr. and 17 gal. of gasoline. Its cylinders would last about 1000 hr. at $1600 per set.

"At the close of 1936, as a result of careful study and practice, these same engines were being operated with no failures for 600 hr. between overhauls, required less than 100 man-hours for complete overhaul, burned less than 1 pt. of oil per hr. and under 14 gal. of gasoline per hr. The cylinders run for 3000 hr. or better. This," he declared, "typifies progress made by the industry."

Mr. Johnston based his talk on the recent visits he made to aircraft factories and airports in European countries, and gave an outline of air-transport development abroad.

Supercharging Not a "Cure All," Says Plumb

● Detroit

"Supercharging may not be applicable to any powerplant nor will it correct all of the troubles which exist prior to its installation," according to R. A. Plumb, Graham-Paige Motors Corp. experimental engineer, who addressed the April 26 meeting of the Detroit Section on "The Supercharger – Its Progress and Prospects." "However," he asserted, "I do believe that the facts bear out the contention that positive induction is fundamentally sound, and a logical way to approach the ideal engine."

Also on the program, a joint student-junior and regular-member session, was Maj. Frederick B. Anderson, commander of the 107th Observation Squadron, Michigan National Guard. The Major gave a practical explanation of instrument flying with Army instruments and also chalkboard diagrams to illustrate modern blind flying technique.

In connection with the supercharging of aviation engines, Mr. Plumb spoke of the China Clipper as an outstanding example. It has been said, he added, that there would be no room for payload if the engines did not employ positive or pressure induction. He showed a series of slides to illustrate the effects of supercharging of aircraft powerplants. "To the average motorist," he noted, "the word supercharger suggests speedway racing with operating conditions under which fuel is sacrificed." In contrast, he described applications in which economy and an improved power-weight ratio are attained.

We now have four major types of such equipment, he said, namely: the plunger pump, the rotary compressor, the Roots and the centrifugal; each of which has its own particular set of characteristics.

There are several reasons why the centrifugal type has been the most popular in America. Mr. Plumb explained. In the first place, he said, such a unit has proved to be the easiest to adapt to our engines and the conditions under which they operate; secondly, it can be made into a simple and durable mechanism which lends itself readily to quality production; and last, all of these desirable qualities may be obtained at reasonable cost.

He noted that centrifugal chargers are not necessarily noisy. That problem has been satisfactorily solved and rotor to crankshaft ratios of the 6:1 order are regularly made so silent that an experienced ear is necessary to detect any supercharger noise when the engine is running on the test stand, let alone in the car, he added.

The "cone" type worm and wheel supercharger drive used by his company was chosen for its silence in operation and resistance to wear, particularly at high speeds, Mr. Plumb stated.

An accessory supercharger being marketed for one of the popular automobile engines was discussed by D. E. Anderson, of the Bohn Aluminum & Brass Corp., Detroit, the principal commentator of the evening. On these engines, he said, the maximum possible commercial compression ratio is 6.75 to 1, with 120 lb. b.m.e.p. Supercharged, with the same compression ratio, smooth operation is obtained with actual b.m.e.p. raised from 117 to 136 and maximum horsepower from 93½ to 125 at 4000 r.p.m., he declared.

Major Anderson explained the operation and function of each of the blind flight instruments, pointing out the need for exact coordination of controls for climbing, gliding, rolling and turning maneuvers of the plane. In addition, he explained the operation of radio beams for guiding planes in fog and storms. To make clear the application of all the instruments and navigational aids for aircraft, he gave typical problems in orientation, using radio beams and cones of silence. He also described the processes followed in making blind approaches and landings after the pilot has established his location and exact altitude above an airport.

SAE *Coming* EVENTS

Fuels and Lubricants Regional Meeting

Sept. 30 & Oct. 1
Tulsa, Okla.

National Aircraft Production Meeting

Oct. 7-9
Ambassador Hotel
Los Angeles, Calif.

Annual Dinner

Oct. 28
Commodore Hotel
New York

National Production Meeting

Dec. 8-10
Flint, Mich.

Chicago—June 16
Acacia Country Club – Annual Golf Tournament.

Detroit—June 25-28
Second Annual Cruise to Mackinac Island via the S.S. South American.

Milwaukee—June 11
Country Club, Racine, Wis. Golf and plant inspection of Twin Disc Clutch Co. plant at Racine.

Northern California—June 11
San Francisco, Cal.

Automobile Called Stimulus of Streamliner

● Kansas City

"The stimulus behind the development of the streamliner was the automobile," claimed E. F. Weber, Burlington Railroad, in his paper: "High-Speed Diesel-Electric Zephyr-Type Trains Now in Operation on the Burlington Lines," the first of two papers read before the meeting of the Kansas City Section, April 23, 1937. Eighty-five were in attendance when Chairman E. W. Pughe, Chevrolet Motor Co., opened the meeting with moving pictures taken by Mr. Weber while traveling on the Burlington Zephyr. In the second paper Diesel fuels were discussed with emphasis on the difficulties in developing new fuels.

The automobile was at once our despair and our inspiration, continued Mr. Weber, for, after it had taken patrons from us, we adopted some of its popular ideas to win them back.

Speaking of the original Burlington Zephyr, he told how the number of passengers had been more than doubled and the cost of operation reduced from about 70 cents to 30 cents per mile as compared with the small conventional train that it replaced. Its weight, including the fourth car, is 135 tons, Mr. Weber stated, compared with 315 tons for the four-car steam train. There are now 20 streamliners in operation, he went on, and more are being built. The Burlington has 8 of them, making more than 5900 miles a day, he stated.

Operating economies come from three sources, Mr. Weber enumerated: the Diesel engine, the light weight, and streamlining. Discussing maintenance Mr. Weber pointed out that the 18-8 (18 per cent chromium and 8 per cent nickel) stainless-steel alloy employed requires no painting, hence the exterior needs only polishing.

The original reason for the development of the Diesel engine must not be forgotten, reminded T. B. Rendel, Shell Petroleum Corp., introducing his paper: "Fuels for High-speed Diesel Engines." The reason is, he explained, that the engine must burn cleanly and completely, without objectionable exhaust smell, the majority of fuels lying within the range of gasoline and heavy residual oils. This characteristic is daily becoming more and more important, he continued, since the higher speed engines are more sensitive to abuse by unsuitable fuels, causing rough running, smoky exhausts, and ring-sticking.

The more important properties to be considered in selecting Diesel fuels are ignition quality, viscosity, Conradson carbon, and cleanliness, Mr. Rendel specified, pointing out the relation of each to satisfactory engine performance.

Ignition quality, believes Mr. Rendel, is by far the most important of these properties from the development point of view, and the major problem in raising the speed of the Diesel engine is one of ignition and distribution in the cylinders.

Speaking of the necessity for control of the delay period, Mr. Rendel said: "In most cases the engine designer is in the best position to exercise the necessary control, although the ignition quality of the fuel is as important and, in cases of bad design, the fuel refiner is called upon to furnish fuel that will ignite quicker."

The ignition quality of a Diesel fuel is very largely, but not quite, a function of its chemical

(*Continued on page* 34)

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Apr. 15, 1937, and May 15, 1937.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Ackmann, Harold H. (A) engineer, Perfex Radiator Co., Milwaukee, Wis.; (mail) 3047 S. Howell Ave.

Almond, John Raymond (M) experimental engineer, Midland Steel Products Co., Cleveland, Ohio; (mail) 9829 Lake Ave., Apt. 202.

Banta, Clifford (M) petroleum technologist, E. I. duPont deNemours & Co., Inc., duPont Bldg., Wilmington, Del.; (mail) 9 Swarthmore Crest, Swarthmore, Pa.

Bauman, John Nevin (M) vice-president, charge of sales, White Motor Co., 842 E. 79th St., Cleveland, Ohio.

Bissell, Thomas A. (M) technical editor, Society of Automotive Engineers, Inc., 29 W. 39th St., New York City; (mail) 237 Madison Ave.

Bolen, Edward P. (A) trim sales engineer, National Automotive Fibres, 19925 Hoover, Detroit, Mich.; (mail) 12202 Glenfield Ave.

Brown, Benjamin Edmund, Jr. (J) assistant instructor, U. S. Diesel Engrg. School, 89 Brighton Ave., Boston, Mass.; (mail) 18 Jameson Road, Newton, Mass.

Brown, Leo F. (J) engineer, General Motors Proving Ground, Milford, Mich.

Burchell, M. J. (M) designing engineer, De Luxe Products Corp., 1200 Lake St., LaPorte, Ind.; (mail) 419 Montrose St.

Carter, George A. (A) sales engineer, Allen Electric & Equipment Co., Kalamazoo, Mich.; (mail) 1215 Bay St., Springfield, Mass.

Chapin, Edward Albert (J) test engineer, research department, Continental Motors Corp., 12801 E. Jefferson Ave., Detroit, Mich.; (mail) 3315 Vinewood.

Connell, Wm. J., Jr. (A) manager, W. J. Connell Co., 121 Brookline Ave., Boston, Mass.

Dillon, H. G. (M) sales engineer, New Departure Div., General Motors Corp., Bristol, Conn.; (mail) 5315 Baum Blvd., Pittsburgh, Pa.

Drescher, Theodore A. (M) manager of transportation, Borden's Farm Products, Div. of Borden Co., 110 Hudson St., New York City.

Fairfield, Wallace M. (J) sales engineer, Fafnir Bearing Co., New Britain, Conn.; (mail) 1253 S. Flower St., Los Angeles, Calif.

Fish, John Robert (A) Research & Engineering Co., 49 Southworth St., West Springfield, Mass.

Frink, Carl H. (M) proprietor, 205-227 Webb St., Clayton, N. Y.

Garton, Frank Leslie (M) associate director, motor testing laboratory, Shell Petroleum Corp., Box 262, Wood River, Ill.

Gibson, George Francis (F M) experimental engineer, Vauxhall Motors, Ltd., Engrg. Dept., Luton, Bedfordshire, England.

Godfrey, E. R., Jr. (M) pilot engineer, Standard Oil Development Co., 26 Broadway, New York City.

Gohn, Emil P. (M) automotive engineer, Atlantic Refining Co., 260 S. Broad St., Philadelphia, Pa.

Gunn, James (M) motor vehicle inspector, Public Utilities Commission, Suite 175, City Hall, Los Angeles, Calif.; (mail) 916 S. Sierra Bonita.

Hertz, Howard D. (J) superintendent, production, Refining Industries, Inc., Portland, Ore.; (mail) 6828 N. Campbell Ave.

Hillery, Jack James (A) charge, automotive maintenance, University of California at Los Angeles, 405 Hilgard Ave., Los Angeles, Calif.; (mail) 11620 Santa Monica Blvd.

Horiak, Erwin A. V., Dr. Ing. (M) research engineer, Hercules Motors Corp., Canton, Ohio; (mail) 1130 Ridge Road, N. W.

Johnson, Richard H. (J) assistant manager, Waukesha Motor Co., Pacific Coast Branch, 939 Santa Fe, Los Angeles, Calif.

Kennedy, Leland J. (J) student, Aviation Mfg. Corp., Lycoming Div., Williamsport, Pa.

Kerns, Peter A. (A) national accounts sales, Goodyear Tire & Rubber Co., 600 W. 58th St., New York City.

Koenitzer, Rolland D. (M) chief engineer, Perfex Radiator Co., 415 Oklahoma Ave., Milwaukee, Wis.

Lawler, John Arthur (J) designing engineer, Evans Products Co., Fullerton at Greenfield Road, Detroit, Mich.; (mail) Franklin Village, Mich.

Logatcheff, Alexander (A) assistant engineer, Spitz Flight Recorder Co., 2712 Hollywood Way, Burbank, Calif.; (mail) 5051 Hermosa Ave., Eagle Rock, Calif.

Lomasney, Edmond P. (J) chemist, Red River Refining Co., Chicago, Ill.; (mail) 8131 St. Lawrence Ave.

Lovell, Wheeler G. (M) assistant head, fuel department, research laboratory, General Motors Corp., Room 11-136, General Motors Research Bldg., Detroit, Mich.

Marks, Stanley G. (M) assistant engineer, Wilcox-Rich Corp., 9771 French Road, Detroit, Mich.; (mail) 831 Oxford Road, Village of Lochmoor, Mich.

Mezey, John B. (A) president, John B. Mezey, Inc., 406 E. 91st St., New York City.

Miller, Avy (J) sales engineer, Frazier-Wright Co., 2315 S. Hill St., Los Angeles, Calif.

Minaker, Harry Lewis (J) mechanic, Packard-Ontario Motors, 1001 Bay St., Toronto, Ont., Canada; (mail) 1635 Gerrard St., E.

Morris, Harold L. (M) chief engineer, Hall Scott Motor Car Co., 2850 Seventh St., Berkeley, Calif.

Page, Frederick Handley (F M) managing director, Handley Page, Ltd., Cricklewood, London N. W. 2, England.

Postmaster General's Dept., Government of the Commonwealth of Australia (Depart'l) Melbourne C 2, Australia. Rep: Brown, H. P., director general.

Ronan, Arthur T. (A) president, T. J. Ronan Co., Inc., 749 E. 135th St., New York City.

Rowland, William Alexander (A) works manager, Steel Co. of Canada, Ltd., Postal Station "C," Toronto, Ontario, Canada.

Samuels, T. P. (A) 1976 S. 80th St., West Allis, Wis.

St. Germain, J. Ross (A) sales field representative, Ethyl Gasoline Corp., 1217 Court Square Bldg., Baltimore, Md.

Savage, Edwin H. (M) special construction engineer, White Motor Co., Cleveland, Ohio.

Scanlan, Thomas A. (A) owner, Scanlan Lock Co., 303 Fourth Ave., New York City.

Sell, Antony (M) body engineer, Fisher Engine Dept., Plant 27, Detroit, Mich.; (mail) 15469 Appoline.

Sloane, Robert Woodward (J) engineering, Monarch Governor Co., 1832 Bethune West, Detroit, Mich.

Societa 'Italo Americana Pel Petrolio (Aff.) Raffineri di Trieste S. Sabba, Italy. Rep: Winchester, J. F., Supervisor of Motor Equipment.

Sonobe, Tsukasa (M) representative, Mitsubishi Jukogyo Kabushiki Kaisha, Ltd., 2-chome, Marunouchi, Koojimachi-ku, Tokyo, Japan; (mail) Mitsubishi Shoji Kaisha, 120 Broadway, New York City.

Stanton, George Taylor (A) manager, technical consulting, Electrical Research Products, Inc., 250 W. 57th St., New York City.

Taylor, Matthew A. (A) division manager, Ethyl Gasoline Corp., 20 Providence St., Boston, Mass.

Tomlinson, E. F. (A) sales, B. F. Goodrich Co., Akron, Ohio.

Waldhutter, Frantisek (F M) general manager, Ceskomoravska-Kolben-Danek, Prague X, Czechoslovakia; (mail) Luzicka 7, Prague-Vinohrady, Czechoslovakia.

White, Haydn James (M) delivery superintendent, Gulf Oil Corp., 1515 Locust St., Philadelphia, Pa.

Zuerl, Donald (J) draftsman, A. B. Chance Co., Centralia, Mo.; (mail) 303 S. Jefferson.

Applications Received

The applications for membership received between Apr. 15, 1937, and May 15, 1937, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Austin, Paul M., superintendent motor transport, Pure Oil Co., Chicago, Ill.

Baird, John H., automotive sales manager, Lubri-Zol Corp., Cleveland, O.

Barnard, Norris C., wholesale sales, Colonial Beacon Oil Co., New York City.

Berna, Tell, general manager, National Machine Tool Builders' Association, Cleveland, O.

Bower, Joe Harry, student engineer, Buick Motor Co., Flint, Mich.

Bott, Rene E., designer, Peugeot Inc., Montbeliard, France.

Brach, Ernest J. W., draftsman, Busch-Sulzer Bros. Diesel Engine Co., St. Louis, Mo.

Brown, Wilfred E., Jr., research associate, Harvard Traffic Bureau, Harvard University, Cambridge, Mass.

Bryant, Don H., salesman, Western Automotive Machine Screw Co., Elyria, O.

Civil Aviation, Department of Defence, Melbourne, Australia.

Cooper, Fred E., owner, P. O. Box 1890, Tulsa, Okla.

Craig, Bruce K., Jr., aero engineer, American Airlines, Inc., Chicago, Ill.

De Clercq, A. E., Detroit manager, Moraine Products, Detroit, Mich.

Dengler, George A. J., chief engineer and general manager, Home Trailer & Mfg. Co., Aurora, Ind.

Denning, William J., general manager, Do Ray Lamp Co., Chicago, Ill.

D'Esposito, Sgt. James F., regimental motor sergeant, U. S. A., Service Battery, 104th Field Artillery, Jamaica, L. I., N. Y.

Drayton, William B., McLaughlin Motors, Inc., Whitman, Mass.

Drummey, John Francis, manager, sales department, Morganite Brush Co., Inc., Long Island City, N. Y.

Fair, David Ramey, branch manager, The vonHamm-Young Co., Honolulu, T. H.

Feiler, Clifford R., draftsman, Busch-Sulzer Bros. Diesel Engine Co., St. Louis, Mo.

(Continued on following page)

FRISCH, LAWRENCE V., automotive engineer, Shell Oil Co., San Francisco, Calif.

FROMM, JOSEPH, service mechanic, The Pure Oil Co., Marcus Hook, Pa.

GADDA, CARLOS M., naval office, Navy Department, Buenos Aires, Argentina, S. A.

GEORGE, GEORGE, technical adviser, Angus & Robertson Ltd., Sydney, Australia.

GOERKE, EDWIN O., chief engineer, Bearing Division, Bohn Aluminum & Brass Corp., Detroit, Mich.

GRAHAM, JOHN A., president, Motor Improvements, Inc., Newark, N. J.

GRUENEWALD, VAL F., superintendent of motor transport, Pure Oil Co., Atlanta, Ga.

HEINE, WILLIAM A., research associate, National Bureau of Standards, Washington, D. C.

HERR, CHARLES H., draftsman, Busch-Sulzer Bros. Diesel Engine Co., St. Louis, Mo.

HOLZWASSER, ALBERT S., treasurer and manager, Arrow Armatures Co., Boston, Mass.

JAMES, WILLIAM JUDSON, draftsman, Busch-Sulzer Bros. Diesel Engine Co., St. Louis, Mo.

JESSUP, HARLAN R., sales engineer, National Supply Co., Philadelphia, Pa.

KARL, WILLIAM CLEMENT, research department, Continental Motors Corp., Detroit, Mich.

KENNEDY, VERNE C., executive vice-president, Truck Leasing Corp. of America, Chicago, Ill.

KERLEY, ROBERT V., assistant mechanical engineer, Materiel Division, Wright Field, Dayton, O.

KLEEBURG, GEORGE F., regional manager, Fleet Sales Division, General Motors Corp., Chicago, Ill.

KNAPP, JAMES CLAYTON, specification division, service department, Hudson Motors, Tilbury, Ont., Canada.

KNIGHT, HENRY H., assistant to president, General Motors Truck and Henry H. Knight Co., Pontiac, Mich.

LARKIN, R. C., president, R. C. Larkin Co., Chicago, Ill.

LARNED, W. E., first pilot, United Air Lines Transport Corp., Chicago, Ill.

LARSEN, NEIL P., vice-president, charge of sales, American Coach & Body Co., Cleveland, O.

LETELLIER, ZENO, vice-president, Pate Oil Co., Milwaukee, Wis.

MARCO, ALEXANDER S., parts and accessory manager, Chevrolet Motor Division, General Motors Sales Corp., New York City.

MARSHALL, EDWARD COWAN, experimental engineer, Wallace & Tiernan Co., Inc., Newark, N. J.

MAYER, LEO, president, Henry Cole-F. C. Hersee Co., South Boston, Mass.

MINCH, J. A., president, American Enameled Magnet Wire Co., Port Huron, Mich.

MINER, SHELDON, salesman, Campbell Oil Co., Indianapolis, Ind.

MOOLMAN, GERHARDUS HUMAN, motor engineer, Lenjane Garage, Dis Vryheid, Natal, South Africa.

MOORE, JAMES BERTRAM, superintendent, motor transport department, Pure Oil Co., Minneapolis, Minn.

MORIMOTO, TATSUMA, chief engineer, Light Motors Co., Tokyo, Japan.

MUNCIE, ALEX, motor transport superintendent, Pure Oil Co., Houston, Texas.

MURRELL-WRIGHT, JOHN FREDERICK, production division, General Motors Near East, S.A., Alexandria, Egypt.

NEPPER, RICHARD CURT, engineer, Ahrens-Fox & LeBlond Schacht Truck Co., Cincinnati, O.

OSPINA-RACINES, E., vice consul, Consulate General of Colombia, New York City.

OTAKE, SHOTARO, director in charge of purchase and material control, Nissan Jidosha Kaisha Ltd., Yokohama, Japan.

PETTET, EDWIN ALVORD, auto electric parts salesman, E. A. Wildermuth, Brooklyn, N. Y.

PHILLIPS, W. ERIC, president, Duplate Safety Glass Co. of Canada Ltd., Oshawa, Ont., Canada.

ROBEY, LIEUTENANT P. H., aero engineer, U. S. Army Air Corps, Dayton, O.

ROSELLO-DUHAGON, FRANCISCO, machinery department, general inspector, Banco Nacional de Credito Ejidal, Mexico City, Mexico, D. F.

RUSSELL, JOHN P., bus manager, J. P. Russell, Inc., Plainville, Mass.

SCHMIDT, DAVID L., test engineer, Cadillac Motor Car Co., Detroit, Mich.

SHAW, C. W., research engineer, Eaton Mfg. Co., Detroit, Mich.

SICKINGER, HANS, owner, Mecano, G.M.B.H., Bockenheimer Anlage 48, Frankfurt A/M, Germany.

SMITH, JAMES M., instructor, Rensselaer Polytechnic Institute, Troy, N. Y.

STANLIK, WILLIAM C., vice-president and general manager, Franklin Weber Motors, Chicago, Ill.

STARR, ALLAN M., consulting engineer, 60 Crest Road, Piedmont, Calif.

SUESS, FRANK A., assistant to chief technician, Continental Oil Co., Ponca City, Okla.

TYLER, SIDNEY LINCOLN, chairman of directors, McIntosh Motors Pty. Ltd., Adelaide St., Brisbane, Australia.

WALKER, CLIFFORD MERRICK, chief engineer, The Triumph Co. Ltd., Coventry, England.

WALTON, WILLIAM L., field engineer, Young Radiator Co., Racine, Wis.

WEICK, ARTHUR C., president, Arthur C. Weick Co., Chicago, Ill.

WENDT, LELAND A., junior engineer, Shell Petroleum Corp., Wood River, Ill.

WETZEL, FRED H., engineer, American Enameled Magnet Wire Co., Port Huron, Mich.

YARNELL, HAROLD ARTHUR, experimental drafting, The Alexander Milburn Co., Baltimore, Md.

ZIPPERLEN, CHARLES P., transportation manager, Breyer Ice Cream Co., Philadelphia, Pa.

ZIURYS, EUGENE J., research engineer, Ethyl Gasoline Corp., Detroit, Mich.

ZUCKERBERG, HARRY, structural engineer, North American Aviation, Inc., Los Angeles, Calif.

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stability, contended Mr. Rendel, adding that there is also some importance of the volatility of a fuel. Crudes which give high-octane-number gasolines yield a low-cetane-number gas oil, and vice versa, he generalized.

It is the control of ignition delay, he pointed out, which is important as opposed to mere elimination of the delay period – as a fuel giving too short a delay can easily upset the designer's arrangement for insuring proper distribution of the fuel within the combustion-chamber and produce a definite loss in power.

Diesel fuel specifications are many and varied, Mr. Rendel concluded, even for almost identical units built by different manufacturers, but the A.S.T.M. has made a good start toward correcting the situation by drawing up a classification for five grades of Diesel fuels, he added.

Students Told of New 40-Passenger Airliner

● N.Y.U.

Advance information on the new Douglas DC-4, 40-passenger airliner featured the talk delivered by Capt. Fred Davis, Eastern Air Lines, at the smoker of the SAE Student Branch of New York University on April 20.

Confirming the rumor that the DC-4 would be equipped with a tricycle landing gear, he stated that the nose wheel is set up just in back of the pilot's compartment and the two rear wheels are just behind the center of gravity so that the airliner rests on the ground at an angle of 3 to 4 deg. instead of the usual 12 to 14 deg. Such a factor greatly facilitates interior design, he explained.

When asked as to whether this airliner would be difficult to land, Capt. Davis replied that the tricycle landing gear arrangement permits braking immediately on touching the ground, (the nose wheel preventing any possible turning over) and, therefore, allows a landing run much shorter than that possible with the conventional airliner of today.

A fair idea of the DC-4's size may be gained from a comparison with the DC-3, which airline publicity men have long peddled to the press as a "mammoth sky giant," he concluded.

	DC-4	DC-3
No. of passengers	40	21
Crew	5	3
Span	138 ft. 3 in.	95 ft.
Length	97 ft.	64 ft. 5 in.
Height	24 ft. 4 in.	17 ft. 6 in.
Engines	4 at 1250 hp.	2 at 1100 hp.
Cruising range	2200 miles	1800 miles
High speed	237 m.p.h.	216 m.p.h.
Gross weight	60,000 lb.	24,000 lb.
Absolute ceiling	24,000 ft.	24,000 ft.
Service ceiling	22,900 ft.	21,800 ft.
Flight on 2 engines at	7,700 ft.	
On 1 engine		8,200 ft.
Useful load	20,000 lb.	8,294 lb.
Mail, Express, Baggage	6,500 lb.	3,450 lb.
Landing speed	68½ m.p.h.	64 m.p.h.

Abell Speaker at Luncheon Meeting

● So. California

"Exploring the Inside of a Modern Engine at 5000 Shots per Second" was Carl Abell's subject at a luncheon sponsored by the Southern California Section, April 21. More than 60 engineers gathered in the Hotel Biltmore dining room of the Engineers' Club to hear Mr. Abell, who is field representative, Ethyl Gasoline Corp. Motion pictures showing flame propagation in the combustion chamber of a gasoline engine running 1200 r.p.m. accompanied the talk.

Oregon Senator Talks Before Student Branch

● Oregon State

Highlights in the history of the automotive industry were reviewed by State Senator Douglas McKay at a meeting of the Oregon State College Student Branch of the SAE on April 22.

In his review, Senator McKay, an Oregon State graduate engaged in the automobile business, sketched the lives of the industry's pioneers and pointed out that there are only 30 automobile manufacturers left out of 500.

To a question on the opportunities for engineers in the automotive field, Senator McKay replied: "There are plenty of jobs open, but few men qualified to fill them."

Diesel and Steam Locomotives Compared

● St. Louis

The thermal efficiency of a Diesel is four to five times that of a steam locomotive, A. R. Walker, electrical engineer for equipment, Illinois Central Railroad, told 100 members and guests of the St. Louis Section at its May 13 meeting. He went on to say that a Diesel engine in main-line service will make from 150,000 to 275,000 miles per year and should run a million miles before the shaft is removed. He also stated that in switching service an engine must work 22 or 23 hr. per day, with only one eight-hour shift off per month.

The success of gasoline rail cars in branch service first turned the attention of railroad operators to Diesel engines, Mr. Walker believes. Because of the high cost and inflammability of fuel, and the fact that gasoline engines would not endure long under the service conditions

imposed by locomotive-engine service, he added, the path was smoothed for Diesel engines.

The meeting was conducted by T. B. Rendel, chairman of the Section.

Ide Joins Delegates to World Petroleum Congress

John J. Ide, technical assistant in Europe, National Advisory Committee for Aeronautics, has joined the group of SAE members representing the Society at the Second World Petroleum Congress being held in Paris the 14th to 19th of this month. The other delegates are C. H. Baxley, Dr. George Calingaert, Alex Taub, T. A. Weir and C. B. Veal, (see May SAE JOURNAL, p. 28).

• It is expected that while in Paris the SAE delegates will also attend the International Congress of the Standardization of the Automobile to take place June 17-19, under sponsorship of the Bureau International de Normalisation de l'Automobile.

Gasoline Declared Poor Parts Cleaner

• No. California

Warning against the use of such hazardous materials as gasoline and other petroleum derivatives for cleaning automotive parts, W. W. Davenport, manager of Turco Products, Inc., spoke of the merits of modern cleaning compounds in his talk before 84 members and guests of the Northern California Section at its May 11 meeting. A. H. LauFer was chairman of the evening.

Besides being highly inflammable, Mr. Davenport stated, gasoline and similar materials thin out and spread grease rather than remove it. He emphasized that specially prepared compounds, designed to clean thoroughly, are not generally more expensive than the more dangerous materials.

His own company, he said, manufactures more than 30 materials to take care of the many cleaning problems arising. The introduction of aluminum and magnesium alloys, he said by way of example, has necessitated the development of cleaning agents which will not pit or otherwise damage the parts which are cleaned. Similarly, he continued, the different bases used for paints and lacquers require a variety of cleaning agents which will permit the removal of these materials effectively. Rust proofing compounds to preserve freshly cleaned surfaces prior to refinishing play an important part in the cleaning cycle, he believes.

It is a misconception to believe that use of cleaning agents necessarily entails the use of steaming vats of chemicals which would dissolve most anything placed in them, he averred, noting, however, that the kind of cleaning agent, its temperature and the period of immersion all have a bearing on the cost and effectiveness of the work. There are now available, he continued, satisfactory cleaning solutions which are used cold and without circulation within the cleaning tank.

Following Mr. Davenport's remarks a talking motion picture, "Grime Marches Off," was shown illustrating the application of modern cleaning processes.

An invitation to attend the Pacific Empire Automotive Maintenance Show held in San Francisco, May 20-23, was accorded members of the Section by J. M. Noble, who managed the exhibit.

Past-Section-Chairman Howard Baxter, who has missed a number of meetings due to a serious illness, was on hand at the May 11 meeting.

Alabama Students See Service Demonstration

• U. of Alabama

Applications of an engine tester to service work were demonstrated by Norman Lancaster, local service engineer, before the SAE Student Branch of the University of Alabama on May 3. Mr. Lancaster also interpreted automobile design changes in terms of their effects on service problems. He told of how the former wasteful practice of replacing entire units, such as the rear end, when some small part failed had been put to an end by competition.

The important part that the engine tester plays in tracking down engine troubles of modern high-compression engines was demonstrated on a car belonging to one of the group by Mr. Lancaster. A spirited discussion followed in which all present joined.

At Wholesalers' Convention

When the National Automotive Wholesalers' Convention of the Pacific Empire was held in San Francisco, May 20 to 23, two SAE members were active on the program. George H. Mosel, general manager, Robison Air Jack Co., was chairman of the entertainment committee and Maj. E. C. Wood, Pacific Gas and Electric Co., addressed the group.

About Authors

(*Continued from page 11*)

• Lieut.-Com. Roscoe F. Good *was reporter on his home-town newspaper when he was appointed to the United States Naval Academy in 1914. That was in Fostoria, Ohio. After graduation from Annapolis he was commissioned in the regular Navy in 1919. Two years later he was transferred to the submarine branch of the service and completed his course at the Submarine School the same year. That started his nine years of service in submarines, three of them on the Asiatic Station. Between sea duty he did two years of post-graduate work in Diesel engineering at Columbia University, receiving his Master's degree in 1926. He has served one year in the Bureau of Engineering, Navy Department, Washington, and two years at the Navy Yard in New York in charge of construction of submarine engines. He has been at the Naval Engineering Experiment Station at Annapolis for the past two years, as superintendent of the internal-combustion engineering laboratory.*

• John Ryle MacGregor *is an alumnus of the University of California, class of '23. After receiving his B.S. in mechanical engineering he attended the U. S. Flying School at Brooks Field, Tex., for one year, and then served as engineering officer, 316th Squadron, U. S. Army Air Service, until joining the research and development department of the Standard Oil Co. of Calif. in 1925. He started with that company as a fuel and lubricant test operator, and was steadily advanced until reaching his present position as fuel specialist. He is active on a number of SAE administrative and technical committees.*

• Charles S. Moore, *since receiving his B.S. degree in mechanical engineering from Worcester Polytechnic Institute in 1927, has been engaged in research on high-speed compression-ignition engines for the National Advisory Committee for Aeronautics at the Langley Memorial Aeronautical Laboratory. He has taken part in the investigation and development of combustion-chamber types and is author of several papers on compression-ignition engine performance.*

• John M. Tyler *has contributed to air, land and under-water transportation. He was called upon to assist in analyzing propeller-drive vibrations of the dirigible "Akron"; in the design of crankshaft torsional vibration dampers for the Winton Diesels used in the new high-speed streamlined trains, and a damper for the U. S. Submarine "Nautilus," in which Sir Hubert Wilkins attempted to reach the North Pole under ice. He took part in solving these problems while at the General Motors Research Laboratory (1927-1935) engaged in vibration and balance studies. During this time also, he had one year of study in Germany under Prof. R. Grammel. Following his work with G.M.C., Mr. Tyler joined the Lycoming division of the Aviation Manufacturing Corp. as head of their analytical department specializing on vibration problems. Early this year he took his present position with Hamilton Standard Propellers division of United Aircraft. Mr. Tyler graduated from Cornell in mechanical engineering in 1927.*

Obituaries

Charles N. Teetor

Charles N. Teetor, chairman of the board and president of the Perfect Circle Co., died at his home in Hagerstown, Ind., on May 2, following a brief illness. He was 65 years old. During all of his mature life Mr. Teetor had been engaged in the automotive industry and had diversified interests in mining and agriculture.

In 1892 he started a bicycle repair shop in Muncie, Ind., and on its floor sketched the vehicle which he later patented as the first railway cycle car.

Mr. Teetor built this car in a little shop in New Castle, Ind., and, though it failed him on the first test run, it was later adopted for railway and other uses. He organized and became general manager of the Railway Cycle Manufacturing Co. in 1895. In 1892 it became the Light Inspection Car Co. After developing a well-known automobile motor the name was changed to the Teetor-Hartley Motor Co. in 1914.

The motor division was sold in 1918 to the Anstead interests of Connersville and the local industry became the Indiana Piston Ring Co., which was renamed the Perfect Circle Co. in 1926. Many of the developments and refinements of the piston ring are attributed to Mr. Teetor's experimentation and invention. He became a member of the SAE in 1918.

G. B. Ingersoll

G. B. Ingersoll, Detroit patent attorney, died April 17. Affiliated with the automotive industry since 1909, when he was tool designer Weston Mott Co., he was later affiliated with Studebaker; National Motor Truck; H. E. Wilcox Motor Co.; Standard Detroit Tractor Co.; Federal Motor Truck Co.; Engine Design Section, New York District, Bureau of Aircraft Production; Duesenberg Motors Corp.; and Lincoln Motor Co.

With Federal Motor Truck Co., as engineer, in 1916-1917, he rejoined that company as assistant chief engineer in 1921. In 1925 he was made chief engineer and later also assumed the duties of patent attorney for that company. In 1932 he left Federal and established offices as patent attorney in Detroit.

Mr. Ingersoll became a member of the Society in 1918. He was 50 years of age at the time of his death.

Light Diesels Featured

J. M. Davies, chief experimental engineer of Caterpillar (*left*), was in charge of all arrangements for plant visits and farm demonstrations during the meeting. He is shown here with SAE President Harry T. Woolson (*right*) who spoke briefly at the closing session.

MANY of the principal problems pressing for solution in the further refinement of heavy-duty, mobile and stationary, internal-combustion power, notably the Diesel engine of the light, high-speed type, were given consideration both in theory and practice at the meeting of the National Tractor and Industrial Power Equipment Activity of the Society of Automotive Engineers, April 21-23, at the Hotel Pere Marquette in Peoria, Ill. More than 350 designers and production men attended. Peoria, one of the strongholds of tractor and industrial power field, and its main industry, the Caterpillar Tractor Co., opened its gates wide for complete factory inspection, later affording inspection of its products at work on a new demonstration field. Covering hundreds of acres, this field provides practically every kind of terrain. The session was well-timed, for it came in the midst of the greatest demand for farm and industrial power in history.

SAE President Harry T. Woolson, Chrysler Corp., and John A. C. Warner, SAE secretary and general manager, expressed the sentiment of all members that the Caterpillar company had done a great job and a truly unselfish one, in the cooperation it gave through its executives and staff of engineers to make the meeting an outstanding success. Later resolutions attesting to that appreciation were adopted by a unanimous rising vote of all present.

Added interest came from the presence of Past President Ralph R. Teetor who spoke briefly on the opening day.

Fuel injections for Diesel engines formed one of the principal topics of discussion, but emphasis also was laid on crankcase ventilation, the effect of addition agents in lubricating oil, service in the field, and the advancement in applying resistance electric welding in the manufacture of tractor parts as an ideal means of cutting production costs with stronger and more reliable components.

"Crankcase Ventilation and Sludge" was the subject of a paper presented at the opening session by W. W. Lowther, Donaldson Co., Inc. Alfred George Marshall, Shell Oil Co. of Calif., presided.

"We find two main types of crankcase ventilation," Mr. Lowther said: "first, the conventional breather, which permits the excess blowby to escape through the breather tube, with no attempt made to introduce fresh air; second, the conventional breather and the road draft tube or its equivalent, the latter in some cases being substituted by a lead to the air intake system, where substantially the same characteristics are obtained. The flow of fresh air was found necessary to carry off the moisture, while the breather was to remove the dust from the ingoing air. This appears to be a workable scheme and is used extensively by passenger car and truck builders, as well as by some of the tractor companies. Closer study, however, shows this system to be set up backwards. By this we mean it has an inadequate flow of air at idle when needed the most, and it has an abundance of air at full load when needed the least.

"By eliminating the elements which contaminate oil, namely, dust, water, acid and dilution, we are destined to experience (1) better lubrication, (2) less oil consumption, (3) less frequent oil changes, (4) greater trouble-free operation and (5) longer engine life."

H. S. Manwaring, L. F. Overholt and Frank Sailer, International Harvester Co., collaborating in a written discussion of Mr. Lowther's paper, agreed that ventilation merits a much greater consideration than it has received in the past. They said the problem is much more complex in the sludge formation in heavy-fuel burning engines. Such experiments, they said, would undoubtedly prove crankcase ventilation effective but not the all-important factor. They consider engines can be satisfactorily lubricated with the proper grades of the more conventional oils rather than with certain additives as some believe necessary. Their tests indicate certain rules essential to sludge control, as follows: (1) Use the best ventilation possible without inducing crankcase depression, (2) use the best available oil filter, (3) develop air cleaner efficiencies as near 100 per cent as possible, (4) take every precaution to seal the engine against dust, (5) keep jacket water temperatures as high as possible, (6) hold crankcase oil temperatures below 180 deg. fahr., (7) design piston and ring assemblies for blowby control, and (8) above all, develop combustion efficiency.

Effects of Additives Reviewed

C. M. Larson, Sinclair Refining Co., following with a paper on the effect of addition agents in lubricating oil on piston and ring performance in gasoline and Diesel engines, said that "with the widening use of Diesel engines as power for equipment, particularly in tractor service, the need for more efficient Diesel lubrication has become apparent. Rugged service and three-shift operation," he continued, "are generally imposed on this type of equipment. The longer the continuity of service operation with straight mineral oils, the more frequent is the enforcement of shutdowns for overhaul caused by poor piston seal, excessive blowby, badly stuck rings, serious oil pumping and excessive wear on cylinder liners and piston rings. . . . High output gasoline and Diesel engine research has shown that a lubricant to reduce ring and cylinder-liner wear and give freedom from ring-sticking should consist of a very stable vehicle plus an addition agent which has proper film strength and adhesion as well as resistance to corrosion and oxidation."

The Caterpillar company was host at luncheon Wednesday noon in the plant cafeteria, following a visit to its showrooms, and later guides were provided for a thorough view of the tractor, road machinery and foundry plants.

Arthur W. Pope, Jr., Waukesha Motor Co., vice-president of the Diesel-Engine Activity of the Society, presided at the Thursday morning session, and announced that H. M.

at National Tractor Meeting

FACTS

about the

National Tractor Meeting

105 different companies were represented.

32 colleges and universities had representatives there.

From 71 cities came the 350 people who attended.

The meeting drew attendance from 18 States, from Canada and from the District of Columbia. 133 came from Illinois; 49 from Wisconsin; 47 from Indiana and 31 from Michigan.

Jacklin, who is professor of automotive engineering at Purdue University, Lafayette, Ind., had brought 29 enrolled students to attend the day's session, and that the delegation was accompanied by Prof. G. A. Young, head of the University's school of mechanical engineering.

Introducing H. C. Edwards, Timken Roller Bearing Co., as speaker on "Fuel Injection Equipment," Chairman Pope said the lack of competitive designs of such equipment in the past was an unfavorable condition which he said he was pleased to see being corrected by the entrance of the Timken company and others into the field of suppliers. Mr. Edwards dwelt upon the application of port bypass fuel injection pumps such as he has designed for the Timken company, and considered engines with four types of combustion chambers, giving these effects:

1. – If it is a direct-injection combustion-chamber, the duration of injection must be short; fuel atomization must be very fine, and penetration moderate; and it will demand a very good control over the rate of fuel entry. Indications are that a multiple-hole spray would be satisfactory.

2. – A combination direct injection and air cell requires fast injection. Not very good atomization is necessary, but high penetration and air control over rate of fuel entry are required. A single-hole nozzle is indicated.

3. – A pre-combustion chamber without turbulence requires a fairly fast injection, fair atomization, low penetration, and fair control over rate of fuel entry. A large pintle nozzle probably would be satisfactory.

4. – A pre-combustion chamber with high turbulence functions best with a moderate injection duration. Good atomization, low penetration, and fair control over the rate of fuel entry are essential. A moderate size pintle nozzle is indicated.

Moyes J. Murphy, Murphy Diesel Co., Ltd., who had been scheduled to present a paper on "Diesel Engines for Agricultural Purposes," was unable to appear, and the remaining time of Thursday morning's session was devoted to the exhibition of four moving pictures provided on short notice by the Caterpillar Tractor Co. These described logging operations in the Pacific Northwest, the Diesel trail to the Orient with the China Clipper, earthmoving operations, and a general view of hundreds of applications of Diesel power over a wide range of operation. The afternoon was devoted to Caterpillar field demonstrations at its new test farm, still somewhat soggy from a torrential rain two days and night before, giving the equipment exhibited true tests of its endurance.

"Resistance Electric Welding," particularly as applied to the manufacture of tractor parts, was discussed by E. A. Mallett, Taylor-Winfield Corp., manufacturer of welding machinery, mostly of highly specialized purpose, at the Friday morning session. He gave credit to Earl R. Graves, supervisor of welding, International Harvester Co., for assistance in supplying factual and graphic information for his paper. John Stevens Erskine, International Harvester Co., Chicago, presided.

Mr. Mallett said that resistance-welding operations are now being performed on a large scale in the steel-working industry.

"For example, in automobile manufacture, where 8 ft. long flash welds in the body, and hundreds of spot welds in both body and frame are made; and at what speed! In one operation alone 215 spot welds in 18 sec. The steel mill, where continuous annealing and pickling operations are made possible by flash welding and special high-speed seam and spot welding equipment for tacking together the ends of coils – and the tractor industry, where spot, projection and flash welding operations are performed on the side rails that form the frame, the wheel tires, steering shafts, starter crankshafts, brake levers, clutch levers, front bolster shafts, front axle shafts, seat supports, seats, fenders, air cleaner pipes and tops, clutch shafts, brake drum covers, transmission covers, fuel tanks."

The paper provoked an animated discussion, particularly with respect to fabrication of fuel tanks. Several members desired to know facts as to defective products, such as leakers. Mr. Mallett said a survey showed 1½ to 2 per cent of leaking tanks and these only by pin-holes which were easily corrected by a swift, inexpensive soldering operation, or by running the leaky weld through the machine.

Elmer McCormick, SAE vice-president, representing the Tractor and Industrial Power Equipment Activity, which sponsored the meeting.

Watching Operations on Caterpillar's New "Demonstration Farm"

(*Above*) A crowd assembles for the operating exhibit of heavy road-building and earth-moving equipment.

(*Below*) Tractor Bulldozer gouging a roadway out of a hillside was one of the dramatic demonstrations.

(*Above*) There was much interest in watching the road scooper and loader at work.

(*Below*) Tractor cranes swinging loads.

Written discussion of Mr. Mallett's paper was confined to comment by H. S. Card, development director, electric welding section, National Electrical Manufacturers Association, who was unable to be present, but commented that "it is obvious enough that resistance welding as a process was just as good 40 years ago as it is today, but that the machines for doing the work described in this paper were not to be had at any price. The fact that it is partly a mechanical process accounts for the very gradual development of its application. The variations in the size and shape of the pieces to be welded make it impossible for the welder manufacturer to standardize his product for such an industry as this. The final result must necessarily wait upon a considerable amount of consultation."

J. Milton Davies, chief experimental engineer; E. W. Jackson, service engineer, and G. C. Riegel, general engineer, Caterpillar Tractor Co., collaborated on a paper entitled "Some Factors Affecting the Design and Performance of Diesel Fuel Injection," read by Mr. Riegel Friday morning. In brief, they agreed that, while the fuel injection equipment is considered as being a relatively delicate part of the Diesel engine, their experience has shown that under the proper operation conditions, the life of the fuel injection equipment is as long, or longer, than other wearing parts of the mechanism.

"It has been clearly demonstrated to us that the major difficulty with the injection system is almost wholly due to dirt in the fuel," the report continued. They disclosed their solution for the problem of dirty fuels from three viewpoints: (1) Discussion of the materials, their heat-treatment and selection, for acceptance in fuel injection parts, expected to minimize the effects due to dirt; (2) design of the injection system to promote easy replacement and service in the field; (3) proper handling of fuel for the purpose of eliminating dirt, and the precautions in the design of the engine to help prevent abrasives from entering the injection system.

As to dirty fuel, the paper complimented the refiners on having approached this problem at the source in a very efficient manner, and it is now largely that of the transportation, container and operator. The Caterpillar company has found the settling-tank method the simplest and most satisfactory method of cleaning it has ever discovered, and it consists of a 540-gal. fuel tank which it has felt constrained to make and offer to the owners desiring it.

R. J. Kretz, service division, International Harvester Co., followed with a paper on "Servicing Diesel Engines" based on experience in the sale and service of International 4- and 6-cylinder Diesel engines in the 50- to 100-hp. class. The former are used in wheel and crawler tractors and as stationary power units, and the latter only for stationary application.

"We have never regarded Diesel engine service as a problem demanding a separate service set-up for its solution – and there has been a very good reason for it," he said. The service man found in the Diesel engine the same simplicity and accessibility as characterized the conventional models. As for the injection system, as a start, an exchange pump service plan was put into effect, while the organization was being schooled in the servicing of this ultra-precision-made piece of equipment and means were being provided for the branch and dealer service organizations to make pressure and distribution tests when replacing pump parts locally. Diesel service was very shortly a part and parcel of the composite service picture.

James B. Fisher, Waukesha Motor Co., presided over this closing session, yielding to Elmer McCormick, John Deere Tractor Co., vice-president of the Activity, who took the chair for a brief business meeting to elect five members on the Tractor Activity Nominating Committee to select a Tractor Activity vice-presidential nominee for the Society's 1938 administrative year.

SAE Summer Meeting Fires Debate from Home and Abroad

(*Continued from page 27*)

out the dangers of applying Mr. Neely's conclusions to service engines, reviewing the differences in conditions existing between them and those of the test machine employed.

"Although we have not been able to trace the simple relationship shown by Mr. Neely," reported F. L. Garton, Shell Petroleum Corp., "experiments made in our laboratory confirm his results."

"Oiliness has long been a cloak for mental laziness," believes Dr. G. H. B. Davis, Standard Oil Development Co., "and Mr. Neely is to be complimented for his work of unmasking."

Dr. John C. Geniesse, Atlantic Refining Co., after confirming Mr. Neely's principal conclusion, voiced a plea for a more fundamental attack of the problem that would include a study of corrosion, adhesion, and the effect of reciprocating motion on lubrication.

Practical tests to confirm Mr. Neely's conclusions were described by Neil MacCoull, Texas Co., showing that, when wear is so great that bearings actually scuff, the friction is less.

"Again Mr. Neely is to be congratulated on the birth of a new testing machine," said William H. Oldacre, D. A. Stuart Oil Co., Ltd., "and we can all share in the joys of its conception."

It appears that Mr. Neely's tests were not oiliness tests at all, contended Joseph A. Moller, Pure Oil Co., if we are to accept the concepts of oiliness held in various definitions, all of which indicate the necessity for fluid-film lubrication instead of the boundary lubrication employed by Mr. Neely.

Setting a new SAE record for words per minute, Mr. Neely answered his discussers in characteristic Floyd Gibbons' style. The data do not relate to engines, wrist-pins, and so on, he explained, but just to the subject itself. As yet, he continued, we have not been able to obtain reliable correlation, joining with several discussers in warning against the application of his conclusions to service applications.

In an intermission between papers, J. B. Macauley, Jr., Chrysler Corp., acquainted members with the material gathered by the C.F.R. Motor Gasoline Survey and the C.F.R. Motor Survey. He was followed by A. W. Pope, Jr., Waukesha Motor Co., who reported briefly for the C.F.R. Motor Fuels Committee.

"A sincere attempt to explain some phenomena attributed to oiliness as mainly the result of viscosity changes, taking cognizance of the effects of pressure and temperature variations on the viscosity throughout the oil film," is the brief estimate of Prof. H. A. Everett, The Pennsylvania State College, of his paper: "High-Pressure Viscosity as an Explanation of Apparent Oiliness."

"This paper deals with the vagaries of performance shown by oils from three different crudes when passing through the test bearing of a machine developed by Prof. L. J. Bradford," he announced. The oils used were matched as to initial viscosity but had widely different viscosity indexes, he explained. The Bradford machine, he continued, is based on Herschel's definition of oiliness: "the property that causes a difference in the friction when two lubricants of the same viscosity at the temperature of the film are used under identical conditions," and accordingly measures relative friction when supplied with oils of matched viscosities, thus ostensibly classifying oils as to relative oiliness.

In making the tests, he pointed out, the difference in temperature between that of the entering oil and a thermocouple junction bedded in the bearing is considered indicative of the amount of work done within the oil film in passing through the bearing. An idea of the successive viscosity changes experienced by a particle of oil is obtained by following its private life in its travel through the bearing, he explained.

What I am going to say is for "dubs" only, prefaced Prof. Walter Lay, University of Michigan, before going back to fundamentals to explain what absolute viscosity and its unit, the poise, are and how they were derived.

A. L. Beall, Wright Aeronautical Corp., stressed the fact that the fixed oils do not act the same under pressure as do the mineral oils. This point should be kept in mind, he cautioned, when fixed oils are used as additives as such additions may change the viscosity at any given pressure.

"Many values hitherto obtained for oiliness actually are only apparent values because they did not take into account both the pressure and temperature coefficients of viscosity," contended Dr. Oscar C. Bridgeman, National Bureau of Standards, in written discussion supporting Professor Everett's conclusions.

"In the light of the SAE Crankcase Oil Oiliness Research Committee's definition of oiliness, Professor Everett's results are in no way related to oiliness unless it can be shown that the differences in temperature differentials, and hence in friction, are greater than can be accounted for on the basis of viscosity alone," reasoned Prof. James I. Clower, Virginia Polytechnic Institute, in written discussion following a comprehensive review of the various concepts of oiliness.

If this new variable, pressure, tends to clarify many of our problems, perhaps we will soon have a "Pressure Index" and be talking about "P.I." as well as "V.I.," suggested G. L. Neely in prepared discussion.

"I do not interpret this paper as indicating that oiliness is not still a problem, but rather that the field covered by oiliness has been narrowed," stated Dr. G. H. B. Davis, Standard Oil Development Co., in prepared discussion.

Professor Everett has done much to disprove the existence of spooks in the "no-man's land" between boundary lubrication and fluid-film lubrication called "partial-film" lubrication, believes Edward R. Barnard, Standard Oil Co. of Ind., in written discussion read by John O. Eisinger of the same company. This dark region has usually been considered a ghostly place, he continued, frequented by such bugaboos as "instability," "erratic behavior," "incipient seizure," and so on. In his opinion fluid-film conditions of lubrication exist when the separation of two rubbing surfaces is three or more times the length of a molecule of the lubricant.

In summation, Professor Everett indicated his agreement with Dr. Bridgeman that the differences observed may be attributable to other than pressure effects, and with Mr. Neely in that a pressure index of the lubricant to correspond with the viscosity index is needed.

Written discussions of one or both papers also were submitted by M. Fairlie, Sinclair Refining Co.; Dr. K. J. De Juhasz, The Pennsylvania State College; Prof. George B. Karelitz, Columbia University; Dr. A. W. Burwell, Alox Corp.; F. L. Garton and H. R. Kemmerer, Shell Petroleum Corp.; and F. A. Faville, Faville-Le Vally Corp.

Rating and Behavior of Diesel Fuels Debated

Recommendations on the best ways for rating Diesel fuels resulting from cooperative tests and investigations of the behavior of 28 fuels of widely varying ignition quality were the subjects of two papers presented at the first Diesel Engines Session, of which A. W. Pope, Jr., Waukesha Motor Co., was chairman.

Design features of high-speed Diesel engines used on 2000 British buses, of the open-chamber type of high-speed Diesel, and of Diesel engines for streamlined trains were reviewed and debated in the second Diesel Engines Session that wound up the meeting on Sunday morning. T. B. Rendel, Shell Petroleum Corp., was chairman.

A direct matching method on the basis of ignition delay is the best method of rating Diesel fuels for ignition quality from the point of view of reproducibility and validity, concluded T. B. Rendel, Shell Petroleum Corp., reading the "Report of the Volunteer Group for Compression-Ignition Research," by himself as chairman and C. H. Baxley, International Aviation Associates, as secretary of the Group. Therefore, he continued, some sacrifice in simplicity and speed of testing must be made. It is recommended, he went on, that the bouncing-pin type of instrumentation should be definitely discarded in favor of the balanced-diaphragm or the magnetic-pickup type. The high-turbulent Diesel conversion of the C.F.R. engine should be used, Mr. Rendel specified, with the exact type of instrumentation for recording the delay left open at the option of the user pending further work of the Group.

The series of cooperative tests that led up to these conclusions were made on 12 fuels using the delay method and critical-compression-ratio method, he explained. Looking toward a simplification and improvement of reproducibility of procedure, he reported, other methods and modifications were studied, including the balanced-diaphragm instrumentation of the Socony-Vacuum Oil Co., the Penn State method, the Sinclair set-up, and the apparatus developed by the Universal Oil Products Co.

New Diesel Fuel Index

A new index of ignition quality called "Ignition Quality Number" was introduced by W. H. Hubner, Universal Oil Products Co. He explained that it is obtained by multiplying the Diesel Index Number by the 50 per cent distillation point and showed slides to show how well it correlated with cetane number by the various methods discussed in Mr. Rendel's report, as compared with Diesel Index Number, Viscosity-Gravity Number, and U.O.P. Characterization Factor. The data are from the same 12 fuels discussed in the report, he pointed out. In proposing this index, we are not attempting to suggest the use of calculated ignition quality as a substitute for engine tests, he qualified.

As we have no C.F.R. engine in South Africa, reported W. H. Higham, Vacuum Oil Co. of South Africa, Ltd., we have used the Diesel Index as a barometer of the ignition quality of Diesel fuels and we find that this index correlates well with service results. It appears that Mr. Hubner's Ignition Quality Number will be even more helpful, he added.

The Sinclair modification of the Penn State method in which they use two neon lamps has our whole-hearted approval, commented Prof. P. H. Schweitzer, The Pennsylvania State College. Suggesting the use of the Viscosity-Gravity Number instead of the Ignition Quality Number, he gave simplicity as the reason for his recommendation. With this sentiment Mr. Hubner expressed disagreement, stating that the simple multiplication necessary to compute Ignition Quality Number was much less involved than the mathematical gyrations required to determine the Viscosity-Gravity Number. Use of the Diesel Index Number was championed by Mr. Rendel, who stressed the psychological value of determining this index in the presence of operators in the field. Dr. A. E. Becker, Standard Oil Development Co., believes that work on calculated index numbers should be encouraged with engine tests as the final criterion.

Telling how he "built Diesel engines before there were cetane numbers to run them," Harte Cooke, McIntosh & Seymour Corp., pointed out that large marine Diesels are not as sensitive to variations in cetane numbers as are the smaller, high-speed engines.

"The outstanding cause of engine roughness with low-cetane fuels is too-early injection," announced R. A. Rose, University of Wisconsin, concluding the paper: "Behavior of High- and Low-Cetane Fuels," which he had prepared with the collaboration of G. C. Wilson, of the same University. The time of beginning of fuel injection should not only vary with the engine speed, but it should be adjustable to suit each different fuel, he continued.

To show that a smooth pressure rise may be obtained if a low-cetane-number fuel is injected late enough, and rough operation if a high-cetane fuel is injected early enough, he displayed oscillograms of tests on 28 fuels varying in cetane number from 24 to 100. The apparatus used to produce the oscillograms, he pointed out, is the same as that described in a paper presented at the 1936 Summer Meeting of the Society, comprising a photo-electric pickup system connected to cathode-ray oscillograph tubes, with the waves recorded on a revolving photographic film. The apparatus recorded simultaneously the pressure, radiation, and injection time, he specified.

We found that, if the fuel is injected at top dead-center, the ignition delay is about the same for the whole range of different cetane-number fuels, he concluded.

In prepared discussion, Professor Schweitzer called attention to the current number of differing conceptions of the ignition point. His discussion centered on the validity of the photo-cell method depending on luminosity employed by the authors. Said he: "Only if it could be shown that incandescence coincides with the beginning of the pressure rise would luminosity become significant. Also," he continued, "the photocell responds to a wide range of infra-red rays that are not luminous to the human eye."

In answer, G. C. Wilson pointed out that it would be a lot easier to devise instrumentation if we could agree on just what is to be measured in ignition delay. To a question of Chairman Pope, he conceded that the finding that ignition delay is about the same for all fuels when injected at top-center "is also puzzling to us and we would welcome explanation of it." Defending the use of the photocell to determine the start of ignition, Mr. Rose quoted an authority, the late Dr. Mendenhall, who had recommended that it was the best method.

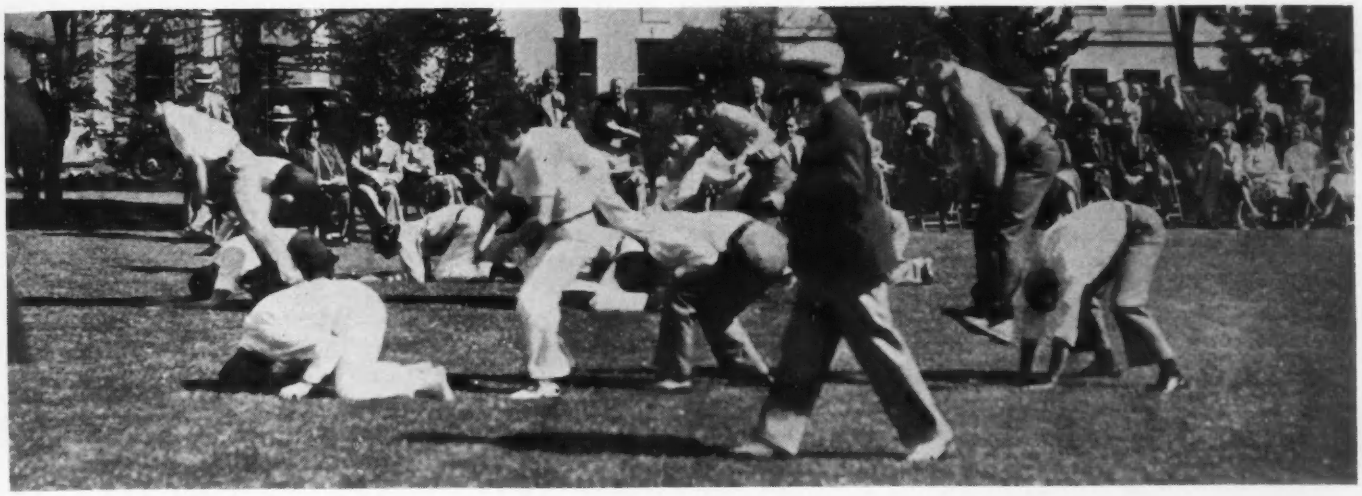
"Not unlike the evolution of living things, high-speed Diesel engines of light, compact structure will oust the heavy and the cumbrous, and those of omnivorous quality always will show a sweeping advantage," was the philosophical conclusion of the Second Diesel Session's first paper: "Recent Trends and Developments in European Automotive Diesel-Engine Design," by H. R. Ricardo and J. H. Pitchford, Ricardo & Co., presented by Mr. Pitchford.

Automotive Diesel-engine development has made such extraordinarily rapid strides in England in the past few years that an unexpected tax on Diesel fuels that brought their price as high as that of gasoline has not checked appreciably its upward progress, Mr. Pitchford reported. Also, he added, the rate of change from gasoline to Diesel engines is more rapid in England than in other European countries where the price differential favors the Diesel fuels.

To the controversial issue of Diesel vs. gasoline engine maintenance costs, Mr. Pitchford contributed: "The London Transport Board who today operates a fleet of nearly 2000 Comet Diesels and about 3000 gasoline buses recently has stated publicly that the maintenance costs of the two types are now about the same, whereas the mileage per gallon of the Diesels is a full 100 per cent greater. As a possible explanation of this

(*Continued on page 42*)

Sports and Games Brought Honor and Prizes to Many



SAE Summer Meeting
GOLF TOURNAMENT

Men's Championship Flight

Winner – J. H. McDuffee 162
Runner-up – C. W. McKinley 168

Class "A" Flight

Winner – J. F. Cast
Runner-up – W. N. Shepard

Class "B" Flight

Winner – F. E. Whitesell
Runner-up – P. H. Oberreutter

Class "C" Flight

Winner – A. E. DeClercq
Runner-up – George F. Crist

Ladies' Championship Flight

Winner – Mrs. H. O. Johnson

Men's Sweepstakes

Tuesday

Raymond Shaw
W. G. G. Godron
Clinton Rector
Hugh Gillies
J. H. McDuffee
Gordon Brown
W. N. Shepard
Ernest Wooler
L. R. Anderson
R. E. Carpenter
H. K. Intemann

Wednesday

W. G. Clark
B. B. Bachman
G. A. Round
R. E. Carpenter
Raymond Shaw
D. E. Gamble
Clayton Farris

Thursday

W. M. Holaday
E. L. Potter
S. J. Williams
W. C. MacLaren
E. W. Austin
V. C. Young
A. C. Chambers
Gordon Brown
N. C. Damon
J. G. Vincent
C. W. McKinley
H. Happersberg
H. L. Sharlock
W. G. G. Godron
R. E. Wilkin

Friday

J. A. Harvey
J. L. Dole
R. E. Wilkin
W. G. Clark
V. C. Young
A. C. Chambers
F. W. Telford
A. J. Scaife
C. W. McKinley
H. H. Knepper
P. J. Kent
W. G. G. Godron
R. L. Morrison
C. E. Brockelbank
G. P. Hall
J. C. Tuttle
J. H. McDuffee
N. C. Damon
Clayton Farris
G. A. Round
F. W. Sampson
G. F. Anderson
D. D. Robertson

Ladies' Kickers Handicap

Tuesday – Mrs. Burns Dick – Net 79
Wednesday – Mrs. R. E. Cole – Net 88
Thursday – Mrs. C. M. Larson – Net 82
Friday – Mrs. Ernest Wooler – Net 87

LADIES' BRIDGE

Wednesday

1st Prize – Mrs. C. H. Baxley 4860
2nd Prize – Mrs. F. L. Faulkner 3280

Thursday

1st Prize – Mrs. W. K. Creson 4040
2nd Prize – Mrs. E. F. Rossman 4020

Friday

1st Prize – Mrs. E. M. Schultheis 4120
2nd Prize – Mrs. P. C. Evans 4010

Saturday

1st Prize – Mrs. R. M. Critchfield 4300
2nd Prize – Mrs. H. O. Johnson 4130

FIELD DAY SPORTS

Ladies

1st Prize – Mrs. E. F. Rossman (36)
2nd Prize – Mrs. W. C. Reese (29)

Men

1st Prize – W. I. Ford (32)
2nd Prize – Sidney Oldberg (28)

LADIES' KENO

Mrs. Clinton Brettell
Mrs. J. G. Vincent
Mrs. G. W. Hobbs
Mrs. J. H. McDuffee
Mrs. J. M. Orr
Mrs. M. B. Chittick
Mrs. S. F. Rolph
Mrs. Sidney Bevin
Mrs. J. C. Tuttle
Mrs. H. H. Knepper
Mrs. Robert Steeneck

showing, Mr. Pitchford pointed out that in England ring-sticking has never been a major problem. We have found that there exists what might be called a "pessimum" oil consumption above or below which ring-sticking does not occur, he reported.

Reviewing advantages and disadvantages of the various combustion systems, Mr. Pitchford related how his company had finally settled on the separate-swirl-chamber type, largely because of its favorable characteristics in minimizing smoke and exhaust smell.

The open-chamber combustion system for small high-speed Diesel engines was championed by M. J. Murphy, Murphy Diesel Co., Ltd., presenting as discussion the paper: "Development of the Murphy Diesel Engine," which was scheduled originally for the preceding Diesel Engines Session.

Mr. Murphy traced the evolution of his small high-speed Diesel engine from a start 20 years ago with an open-chamber combustion system, through various highly turbulent designs and gas-injection precombustion types, and then back to his present full Diesel with open combustion-chamber and unit injector. We finally came back to this type, he stated, because we believed that its simplicity and symmetry as exemplified in the larger marine engines made it best also for small high-speed engines. Although, he conceded, turbulence and unsymmetrical design do work well in small engines.

The successful development of a small high-speed Diesel of this type, Mr. Murphy explained, can be attributed to the unit injector employed which leaves out the fuel line and uses plain drilled-hole nozzles. This fuel system, he continued, injects the fuel in step with the rotation of the engine's crankshaft. Highly turbulent types of combustion-chamber are needed when the fuel is not under control, he concluded.

Amplifying Mr. Murphy's discussion Prof. P. H. Schweitzer, The Pennsylvania State College, pointed out that the turbulent type of combustion-chamber appeared to be a necessity for variable-speed engines, and not for those of constant speed. He agreed with Mr. Murphy on the necessity to synchronize injection with the crankshaft rotation for the open-chamber type. Studies of hundreds of injection cards have shown, he reported, that the curve of the open-hole nozzle starts steep and falls off rapidly giving a sudden surge that makes for rough operation. The pintle-type nozzle discussed by Mr. Pitchford does not have this characteristic, Professor Schweitzer concluded. In reply Mr. Murphy told how he had eliminated this sudden-surge characteristic.

In reply Mr. Pitchford agreed with Mr. Murphy on the importance of synchronized fuel injection and that symmetry and simplicity are absolutely essential for the larger size engines. To a question of W. H. Hubner, Universal Oil Products Co., he stated that the trend in the cetane requirements of fuels in England was downward, and is due mainly to development in engine design. Answering W. E. Lerch, Hemphill Diesel Engineering Schools, he told of their efforts to get smokeless exhaust by proper training of operators, by use of a fuel stop, and attempts at controlling the exhaust by means of a photocell to measure the smoke. The maximum m.e.p. of the buses is 123 lb. per sq. in., he reported.

To a question on the status of Diesel aircraft-engine development in Europe, Mr. Pitchford replied that the Germans are ahead in air-cooled Diesels, telling of successful flights across the Atlantic in planes powered with Junkers Diesels. In England there is a lot of development work going on, he continued, but mostly on liquid-cooled types. From the military point of view, he explained, the advantage in favor of the Diesel in reduced fire risk is not considered important.

Development of Diesel engines as a source of motive power in railroad transportation has been hampered by the necessity of using engines designed for marine service, stated F. J. Jumper, Union Pacific Railroad Co., in his paper: "Diesel Streamliners – Operating and Maintenance Problems." As a result, he continued, a number of problems different from those encountered in stationary or marine service have arisen, such as weight, limited space, cooling systems, variable speed, and continuous full load.

In describing the six streamliners now in service for the Union Pacific, he pointed out that automobile engineers had cooperated with them to produce the distinctive front ends of several of the power cars. Two new trains now under construction will be the largest and most powerful Diesel-electric trains ever built, Mr. Jumper announced. They will be built of welded alloy steel, he continued, and each train will consist of 3 power cars and 14 trailing cars, each power car being equipped with two 900-hp. Diesel engines each direct-connected to a generator. Fuel consumption on present units is between 0.48 and 1.11 miles per gal., he concluded.

Any machine has to go through a process of development, and this development can come only through the experience gained by pioneering such as is being done by the Union Pacific with Diesel streamliners, contended Harte Cooke, McIntosh & Seymour Corp.

Complimenting Mr. Jumper on his Diesel maintenance organization, A. W. Pope, Jr., Waukesha Motor Co., placed responsibility for any lag in development of high-speed automotive Diesels behind that of Europe at the door of American operators and maintenance.

There is no tendency to replace Diesel units with steam locomotives, replied C. M. Beard, Union Pacific Railroad Co., to a question of Harry T. Woolson, Chrysler Corp., stating that the high-speed steam units mentioned in the paper were reconditioned steam locomotives. The only changes in the tracks necessary to accommodate Diesel streamliners was to increase the spiral in some of the curves to take care of the higher speeds, was his answer to another discusser.

Oil consumption is only about 25 gal. on a 5000-mile round trip, Mr. Beard specified, answering P. M. Heldt, *Automotive Industries,* as we get about 85 per cent reclamation. A Diesel streamliner weighs about half as much as an equivalent conventional steam train, was Mr. Jumper's answer to a question by T. S. Campbell, Euclid Road Machinery Co.

We are able to run steam locomotives at higher speeds without excessive vibration because of cross-counterbalancing the locomotives, explained Mr. Jumper in answer to Mr. Pope's question.

Discussion Spotlights Lubricants at Hypoid Forum

Hypoid gears, axles, and their lubricants received thorough going over in papers prepared and read by W. A. Witham, Gleason Works, and by C. M. Larson of the Sinclair Refining Co., Inc., at the Saturday morning session. Discussers, called upon by Session Chairman Ernest Wooler, Timken Roller Bearing Co., augmented, and in some instances questioned the opinions of the authors.

Hypoid gears are now being produced to a higher degree of accuracy and precision than it has heretofore been possible to produce *any* type of rear axle drive, declared Mr. Witham, the first speaker, who added that, perhaps, the most noteworthy advance in this direction has been the introduction of the single-cycle method of cutting Formate or non-generated gears. These, he said, differ from generated gears primarily in the amount of profile curvature, pointing out, that in a generated set correct conjugate tooth action is obtained by making the profiles of both the gear and the pinion substantially involute.

(*Continued on page* 48)

What

Foreign Technical Writers Are Saying

AIRCRAFT

Zur Frage der Widerstandsverringerung von Tragflügeln bei Uberschallgeschwindigkeit durch Doppeldeckeranordnung

By O. Walchner. Published in *Luftfahrt-Forschung*, Feb. 20, 1937, p. 55. [A-1]

At speeds surpassing that of sound, thin profiles are known to have better aerodynamic characteristics than thick. A thin, flat plate has the best lift-drag ratio, but this wing form can not be used because of its lack of rigidity. According to A. Busemann, two profiles of a given thickness can be so arranged with respect to one another that the forces on both together, in even, frictionless flow, are equal to or less than those on a single thin plate. The air flow lines for such a double-profile, with and without angle of attack, are constructed and the forces calculated. The basis used is the Prandtl-Meyer solution for flow about corners.

Schiebende und Gepfeilte Tragflügel

By F. Weinig. Published in *Luftfahrt-Forschung*, Feb. 20, 1937, p. 45. [A-1]

Since with favorable aspect ratio the curvature of air flow can become negligible, certain simplifications may be made in calculating the effect of the shape of the wing axis on lift distribution. The deviation of the wing axis from a straight axis has the same effect as the deformation of an otherwise similar wing with a straight axis. On this basis, calculations are carried through, for the case of constant lift distribution, for wings of the same chord, in rectangular, arched and streamlined forms. Finally, conversion equations are given for wings of any given chord distribution.

Sur le Calcul des Poutres en Caisson

By Léon Kirste. Published in *L'Aéronautique*, January, 1937, L'Aérotechnique section, p. 1. [A-1]

The structure of cantilever wings, in general, is comparable to a box-girder, with four sides, and with variable sections and proportions along the wing span. The exact design calculations applied according to the classical method involved a system of differential equations, the solution of which requires much time and effort; furthermore, the characteristic values and their effect on the final result can not be distinguished. The method proposed is said to overcome these disadvantages; based on a study of internal deformation, it consolidates all the unknown variables in a single value, which can be graphically determined. The values of interest in design, it is said, may then be derived by means of very simple relations.

Uber die bei Einleitung von Längskräften in Zylinder-und Kegelschalen Auftretende Beanspruchung von Ringspanten

By K. Drescher and H. Gropler. Published in *Luftfahrt-Forschung*, Feb. 20, 1937, p. 63. [A-1]

When longitudinal forces are exerted on a monocoque structure, bending moments are induced in the circular frames. To avoid the customary involved calculation of these bending stresses, the method here presented has been developed. The case considered is that in which two circular members of constant strength throughout their circumference are provided at the point of application of the force, in monocoque structures of cylindrical or elliptical cross

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

section. The bending moments for a few loading cases are calculated and represented in graphs.

Druckverteilungsmessungen im Fluge an einem Flügelschnitt mit Landeklappe

By Georg Kiel. Published in *Luftfahrt-Forschung,* Feb. 20, 1937, p. 71. [A-1]

Flight measurements were made of the pressure distribution over a wing with a landing flap, with the flap adjusted at various angles. The results of these measurements and conclusions drawn from them are reported, and the test apparatus and methods are described. A Fieseler F 5 airplane was used in the investigation.

Some Problems of Modern High-Duty Aero Engines and Their Fuels

By F. R. Banks. Published in the *Journal of the Institution of Petroleum Technologists,* February, 1937, p. 63. [A-3]

The author undertakes in this paper to give those who specialize in fuel some idea of the aircraft engine problems involved and the engine specialists some information on the latest fuel developments.

Part I reviews the present fuel position, fuel rating and correlation of laboratory and performance results. Part II is devoted to aircraft engine developments which are covered in detail under the following heads: cylinder head and combustion chamber design, valves, exhaust pipes and collector rings, sparking-plugs, cold corrosion, light alloy fuel tanks and leaded fuel, further problems relating to the application of high octane fuels, maximum power production, minimum fuel consumption, general discussion, air cooling versus liquid cooling, and miscellaneous problems.

In conclusion Mr. Banks expresses the hope that he has provided sufficient practical information to give some idea of the difficulties encountered by the aero engine manufacturers in the development of their engines and a glimpse of the efforts which are being made by the oil companies, in order to assist the aero engine to progress. Reprints of recent papers pertinent to this subject are included as appendices and lengthy discussion of Mr. Banks' paper is recorded.

Contrôle non Destructif des Assemblages Tubulaires Soudés Utilisés en Construction Aéronautique

By Armand Petiniaud and Robert Schmidt. Published in *L'Aéronautique,* January, 1937, p. 3. [A-5]

A method for determining defects in welded joints in aircraft structures by means of X-ray examination is described. X-ray examination of such welds must overcome two difficulties: first, the variations in the shape of the weld itself produce differences in X-ray absorption of such magnitude as to far outshadow the differences due to internal defects in the weld; second, certain secondary parasitic radiations which interfere with the interpretation of the radiograms must be eliminated. Both problems are said to be solved if the welded joint is observed through a screen of average opacity to X-rays. Then the major differences in absorption due to the form of the weld become relatively less important, while the defects still make themselves visible on the X-ray photograph. The secondary radiations are wholly absorbed by the filter.

Directions are given for putting the suggested method into operation, covering the following points: nature and thickness of the filter, the incidence of the X-rays, and the interpretation of the radiographs.

Other precautions taken in France to assure correct welding of aircraft structures are the strict licensing of welders engaged in such work and standards enforced covering material and methods used in welding. In view of all these precautions, the authors contend that welding merits continuous development and increasing application in aircraft construction.

ENGINES

Zur Berechnung von Kurbelwellen

By Dr. Geiger. Published in *Automobiltechnische Zeitschrift,* Feb. 25, 1937. [E-1]

The author cites and criticizes a few methods now in use for calculating the design of crankshafts. He expresses the opinion that many other factors besides static strength must be taken into account in the design of a crankshaft, such as dynamic strength, bearing area and lubrication. These questions must all be considered in the preliminary design of the shaft, and then its dimensions must be determined by strength calculations. The formulas customarily used for such calculations do not agree with results of practical tests, since accurate determination of the actual stresses found in a multi-throw and multi-bearing crankshaft can be arrived at only if the effects of the various throws and bearings, as well as of increased strain due to relatively abrupt change in cross section, are considered. The object of this paper is to develop a simple, easily usable method for calculating crankshaft dimensions that will meet these requirements.

Betriebsprobleme der Hochspannungszündung

By A. E. Thiemann. Published in *Automobiltechnische Zeitschrift,* Feb. 25, 1937, p. 99. [E-1]

In this discussion of operating problems encountered with high-tension ignition, the author assembles information previously published in German, French and American periodicals. He concentrates on the spark plug, and reproduces numerous graphs developed in the work of earlier investigators.

Some of the topics dealt with are: spark plug

temperature and the effect of numerous factors on it; classification and effect on performance of deposits on spark plugs; insulating and electrode materials; especial difficulties encountered with aircraft-engine spark plugs, specifically those due to radio shielding; voltage requirements at the spark plug and the effect of various factors on it, among others the ionization of the spark gap.

HIGHWAYS

Strassensteigung und Brennstoffverbrauch

By L. Richter and R. Vetiska. Published in *Automobiltechnische Zeitschrift*, Feb. 25, 1937, p. 88. [F-1]

A 6 per cent road grade involves about 50 per cent greater fuel consumption than a level road; and where grades are broken, grades of less than 3 per cent are advisable. These are conclusions drawn from an analysis, based on engine bench tests and calculations, made by the commercial association of instructors in the Austrain colleges. The object was to furnish to highway engineers information on the economics of road grades from the viewpoint of the automobile operator. The most unfavorable operating conditions were selected for the analysis, i.e., a $2\frac{1}{2}$ ton motor-truck driving on one axle, having five forward speeds and powered by a Diesel engine of about 160 cu. in. capacity.

As part of the analysis curves are presented showing, for this vehicle: the relation between torque, fuel consumption and engine speed; the torque required to overcome rolling resistance at various speeds; the fuel consumptions for various vehicle speeds and for various grades, using different gears; and the fuel consumption and time required for achieving a given difference in road levels with the use of various grades.

MATERIAL

Einwirkung Elastischer Spannungen auf die Thermokräfte

By F. Lichtenberger. Published in *Luftfahrt-Forschung*, Jan. 20, 1937, p. 26. [G-1]

This report deals with methods of measuring internal strain in metals due to alternating stresses. In thermo-electrical measurements, it was thought, elastic tension might affect the thermo-electrical forces sufficiently to cause considerable error in the measurement of mechanical tension. After reviewing previous work on this thermo-elastic effect, a simple method of measuring it is described, and results obtained reported. The results obtained indicated that the effect of elastic tension on thermo-electrical forces is so small that, in the usual type of investigation, it may be neglected, but that, where extreme accuracy is desired, it may cause considerable error. In the measurement of elastic oscillating tension, also, the thermo-elastic effect has practical significance. On the basis of these findings, a new method for the measurement of oscillating stresses is proposed.

Lagermetallprüfmaschine mit Dynamischer Belastung

By H. O. Heyer. Published in *Luftfahrt-Forschung*, Jan. 20, 1937, p. 14. [G-1]

To test the suitability of bearing metals for the main bearings of aircraft engines, a dynamic bearing-metal test apparatus was developed in the materials testing laboratory of the German Institute for Aeronautical Research. The apparatus simulates operating conditions, in the degree and rate of loading, temperature and rubbing speed. The degree, direction and rate of loading are controllable. The loading of the bearing can be observed visually by means of a piezo-electrical pressure measuring apparatus in connection with a cathode ray oscillograph.

Comparative tests show agreement between the wear as experienced in the test apparatus and that occurring in service in the engine. Tests were made to show the effect of varying loading rates with the same maximum load. The possibility of affecting the loading rate on the bearing through design was noted. This offers an opportunity of improving the operating conditions of the bearing.

Technische Oberflächenkunde

By Gustav Schmaltz. Published by Julius Springer, Berlin, Germany. 286 pp.; 395 illustrations. [G-1]

This book deals with the physical and engineering aspects of the surface of engineering materials, especially machine parts. Both the microstructure and physical characteristics of metal surfaces are included in the discussion. The author has broken down the content of his book into many subdivisions, and has indicated for each subdivision the class of reader most apt to be interested, the student, designer, production or research engineer. The discussion is based on investigations carried out by the author and by others in the field, and the many references to original reports constitute an extensive bibliography.

Among the subjects covered are fundamental conceptions involved in the study of metal surfaces, the relation of surface structure to design and production, methods of testing metal surfaces, a critical estimate of these methods, a quantitative measurement of surface roughness, the technology of machined metal surfaces and the structure and condition of typical machined surfaces, the relation between surface and such characteristics as strength, friction, wear, fit and heat conductivity, and the standardization of surface finishes.

Erdöl-Untersuchungsmethoden

By Erich Molnar. Ö.P.I. Report No. 7. Published by Verlag fur Fachliteratur Ges. M.B.H., Vienna, Austria. 167 pp. [G-1]

A concise summary of methods for testing petroleum products throughout the world is here presented. Only methods commonly used for engineering or commercial purposes are included; purely scientific procedures, or those developed for some special purpose are omitted.

The book is divided into four sections, dealing respectively with gasoline, kerosene, gas-oil and lubricating oil. In each a table sets forth the testing methods, arranged according to countries, about 25 countries being included, and according to the characteristic determined by the test method. The methods are classified according to the degree of authorization they enjoy in their native land. Three classifications are used: first, a standard method sponsored by an official standardization body; second, a method adopted by a technical or commercial organization in good standing; and third, if no method is available in either of these two classifications, any procedure used.

Each section contains two appendices, the first briefly describing the methods listed in the table, with references to original sources in which complete descriptions may be found; the second dealing with the comparison of results obtained by different methods for determining the same characteristic.

The Austrian Petroleum Institute requests that it be informed of any errors or omissions in this first edition, so that these may be corrected in later issues. An English edition is now being prepared.

MISCELLANEOUS

Vier Jahre – das Wunder Deutscher Motorisierung

By Edgar Schley. Published in *Automobiltechnische Zeitschrift*, Feb. 15, 1937, p. 53. [H-6]

In the four years since Leader Hitler introduced his program for the stimulation of the German automotive industry, the number of vehicles in operation in Germany has increased from 1,633,000 to 2,475,000. The proportion of the 50 per cent increase is slightly in favor of passenger-cars as compared with motor-trucks. Opportunity for further expansion still exists, since Germany is the fourth nation in the number of vehicles in operation, and in the number of vehicles in proportion to population, there being one vehicle to every 54 inhabitants.

The number of new vehicles licensed in 1936 still shows a percentage gain over 1935, but the percentage gains over the preceding year have decreased steadily since 1933. These percentage gains of new vehicles licensed over the preceding year are: for passenger-cars, 1933, 99.7 per cent, 1934, 59.7 per cent, 1935, 37.6 per cent, 1936, 18.4 per cent; for motor-trucks, 1934, 102 per cent, 1935, 41.1 per cent, 1936, 36.4 per cent. In the popularity of sizes, the trend in passenger-cars is opposite to that in motor-trucks. In passenger-cars, the proportion of the total in the three larger sizes in 1932 was 15.9 per cent, and in 1936, 8.1 per cent. In motor-trucks, the proportion of the total in the three larger sizes in 1933 was 13.1 per cent and in 1936, 18.7. By 1935 German automotive concerns had made good losses of previous years and were paying dividends.

Two tables are presented for each of the following five types of vehicles: passenger-car, motor-truck, tractor and trailer, three-wheel vehicle and motorcycle. The first lists the number of new vehicles for each year since 1932, classified according to size. The second lists for 1935 and 1936 the number of new vehicles by make. For the present year a replacement market in the higher-priced classes is anticipated as the most important development in passenger-car sales, while motor-trucks are expected to find new classes of purchaser.

PASSENGER CAR

Personenkraftwagen auf der IAMA 1937

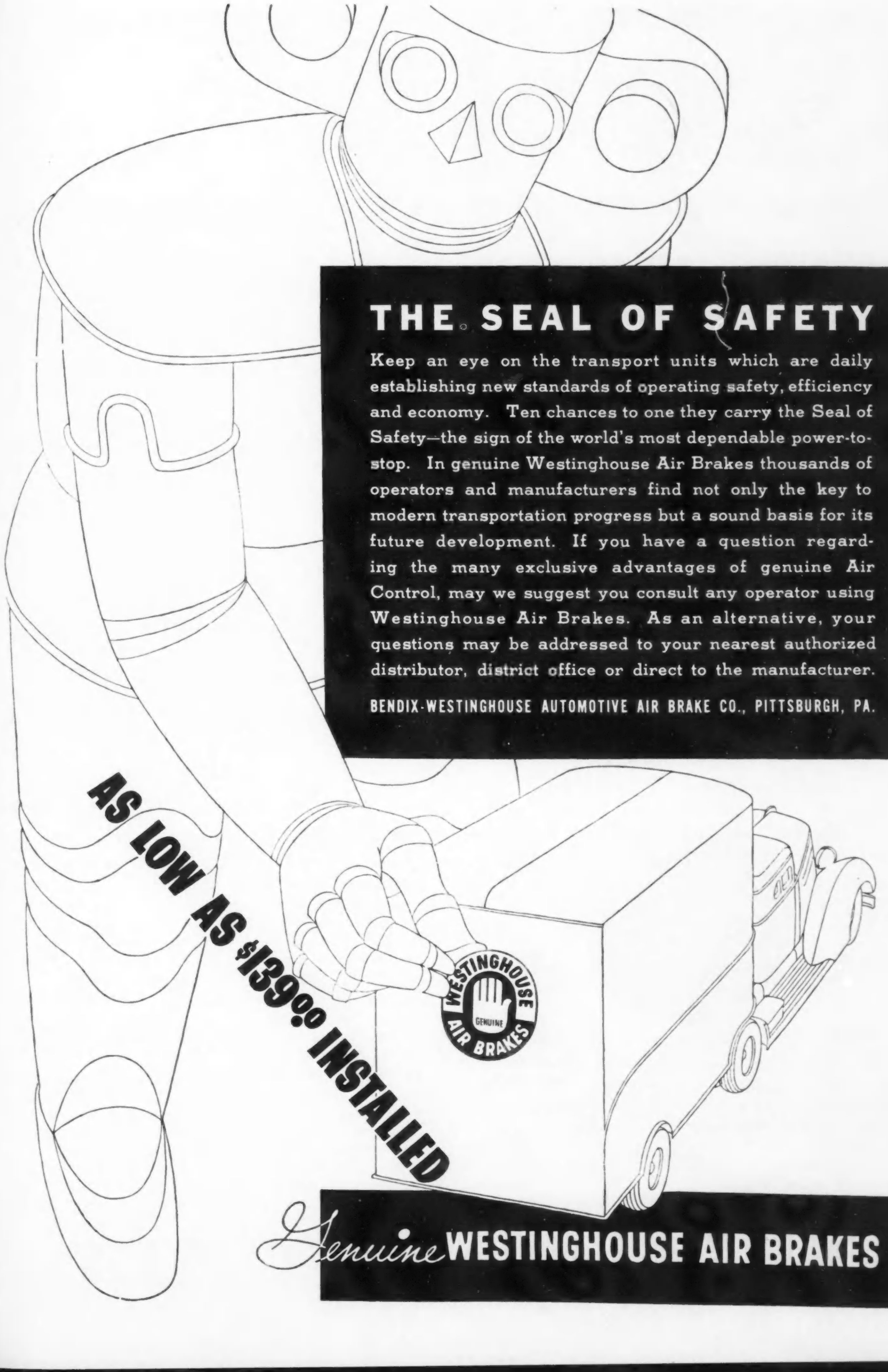
Published in *Automobiltechnische Zeitschrift*, Feb. 25, 1937, p. 81. [L-1]

The highest-speed production passenger-car in the world is the character accorded the large Mercedes-Benz exhibited in this year's Berlin show. No major new design features are incorporated in the current models of this make, but two new types have been added, as well as such refinements as a dual downdraft carbureter, with accelerating pump, starting and economiser adjustments and, for the Diesel, an electrical fuel vaporizer for greater ease in cold starting.

Two new models have been added to the Adler line of three, one of the new models being provided with a reinforced frame and a connection for trailer hauling. The Opel line has also been enlarged, to increase the price range offered. Wide seats, draft-free ventilation, dust proof baggage compartment and hydraulic brakes are some of the special features mentioned.

The Maybachs are, as usual, the giants of the show, and the following makes also offered refined and more numerous models: Vidal & Sohn, Framo-Werke, NSU, Auto Union, Audi, DKW, Horch, Wanderer, Bayerische Motoren-Werke and Hannoversche Maschinenbau. Special mention is made of the power increases in the Hanomags.

Supplementing this article, which points out the new passenger-car developments at the show, are two articles in the March 5 issue of *Automobiltechnische Zeitschrift*, p. 111 and p. 116, in which current models are described and specifications given.


THE SEAL OF SAFETY
Keep an eye on the transport units which are daily establishing new standards of operating safety, efficiency and economy. Ten chances to one they carry the Seal of Safety—the sign of the world's most dependable power-to-stop. In genuine Westinghouse Air Brakes thousands of operators and manufacturers find not only the key to modern transportation progress but a sound basis for its future development. If you have a question regarding the many exclusive advantages of genuine Air Control, may we suggest you consult any operator using Westinghouse Air Brakes. As an alternative, your questions may be addressed to your nearest authorized distributor, district office or direct to the manufacturer.
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AS LOW AS $139.00 INSTALLED
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The Formate-gear profile, he continued, is made straight, being formed by a cutter having straight blades. The pinion is generated to be correctly conjugate to this type of gear. He noted that the actual difference in profile shape between a generated gear and a Formate gear of 10 in. diameter, and 40 deg. spiral angle is only 0.003 in. to 0.005 in.

Now, he stated, the Formate gear is displacing all others for quantity production chiefly because of a new machine and a new type of cutter which will produce more accurate gears at a faster rate than it has ever been possible to produce any bevel gear. The author briefly described this machine.

Regarding tooth loads, Mr. Witham explained that due to the lower spiral angle of the hypoid gear, the normal tooth load is substantially less than on a spiral bevel gear of the same diameter, carrying the same torque.

Gear tooth breakage, Mr. Witham said, will probably never occur in hypoid axles in ordinary service, providing that reasonable care is taken in the design of the axles, in the cutting of the gears, and in the final assembly.

In concluding, Mr. Witham explained the method of testing hypoid lubricants for load-carrying capacity as carried on at the Gleason Works for the past 12 years.

He also cited the following primary requirements for a suitable extreme-pressure lubricant for hypoid gears: sufficient load-carrying capacity or E.P. value; absence of abrasive action; stability in service and storage; absence of corrosive action.

There are now, he said, a considerable number of highly satisfactory hypoid lubricants being marketed on a sufficiently large scale to insure proper service to every automobile owner.

That the SAE lubricants testing machine, when operated with a given set of conditions, accurately and positively predicts the operation of hypoid lubricants in actual car operation or in the test used by the Gleason Works, was maintained in discussion by W. H. Graves, Packard Motor Car Co. He noted that his company will approve for service any lubricant meeting a certain specification that his company has set up, one of the most important points in which is the load-carrying ability of the lubricant as determined on the SAE machine when operated at 1000 r.p.m., with a rubbing ratio of 14.6 to 1, and at a loading speed of 83.5 lb. per sec.

H. C. Mougey, Research Laboratories division of General Motors, stated that his company does not have a specification for hypoid gear lubricants, although a proposed tentative specification has been distributed to a large number of men in the oil and automotive industries for comments and criticism. The G.M.C. car divisions, he noted, have made tests on well over 200 lubricants in cars at the proving ground which have been the basis of approved lists issued to their dealers.

Laboratory tests on these lubricants, he continued, have shown very definitely that no single test, except a very severe service test, can be used to determine if a lubricant will be satisfactory in service.

R. M. Riblet, Timken Roller Bearing Co., pointed out that as soon as the car manufacturers find from service experience that their hypoids are successful they will begin to increase the tooth loads, as they did in spiral bevels. Mr. Riblet also stressed the importance of rigidity for hypoid-gear mountings.

Taking the marketers' point of view C. M. Larson pointed out the need for simplifying recommendations of transmission and rear-axle lubricants. Never before, he said, have we had a more complicated and varied number of gear lubricant recommendations for the millions of cars on our highways.

Each year as new features are being introduced, he con-

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tinued, changes are made which affect gear lubricant requirements of the past, yet nothing is done to revise the car manufacturers' lubrication charts made up previously each year. Mr. Larson declared that a composite grouping of gear lubricants would simplify the servicing of cars on the road.

In concluding, Mr. Larson stated, "So long as car manufacturers recommend against the use of E.P. lubricants for transmissions, overdrives or for use in rear axles, there will be confusion. Tests and experience have shown that highly-stable, non-corrosive mild E.P. lubricants are available which have resistance to oxidation, sludging and corrosion equal to the highly filtered motor oils or bright-stock straight mineral oils. The future points to this type of lubricant for use in all passenger transmissions and rear axles, except where the powerful hypoid lubricant is recommended for hypoid rear axles."

H. R. Wolf of General Motors Corp. declared that the automobile manufacturers are in accord with oil companies to reduce the required number of lubricants. He pointed out, however, that there are not suitable classifications or specifications to insure the automotive engineer that only lubricants of proper quality will be available to the car owner.

If the automotive engineers could get together on design, the lubrication problem would be much simplified, in the opinion of O. L. Maag, Timken Roller Bearing Co. He brought attention to the two schools of thought regarding extreme-pressure lubricants, explaining them as, "one feeling that only the so-called high-powered, active-sulphur type of lubricant which carries the full load on the SAE machine will take care of hypoid gears; the other, which from all information we have, is just as successful using the so-called mild extreme-pressure lubricants, rated low by the SAE machine." The latter lubricants, he said, are generally conceded to be of the more stable type and likely to give less trouble from separation and settling in storage.

Suggesting that powerful E.P. lubricants could better be termed "anti-weld" type of lubricants and that the mild type should just be called "extreme pressure lubricants," J. A. Moller, Pure Oil Co., told of tests leading to the conclusion that in powerful anti-weld lubricants that "as long as the sulphur remained active and the lead-soap remained in suspension, a high anti-weld, or adhered film, remained on the teeth which not only permitted abrasion, but fostered it to an extent of many times that encountered with the so-called mild type. Further, that when the sulphur became practically or totally inactive – either through being combined with the oil, or forming sulphides, etc. – and part or all of the lead dropped out, or was centrifuged out, wear promptly decreased."

Mr. Moller also made the plea that if car manufacturers have any idea of increasing loads and speeds for 1938 axles that they call upon every major oil company so that problems of design lubrication can be worked out before a mechanism is presented to the public, rather than fought out afterwards.

The desire of having something better than last year's cars to work with was also voiced by W. H. Oldacre, D. A. Stuart Oil Co., Ltd. He feels that the Society should be turned to for pure research – free from any commercial aspect.

W. S. James of Studebaker called attention to the fact that there have only been about six months of actual experience on most hypoid installations, and warned the industry not to freeze to a particular type of lubricant, so as to be unable to change as occasions arise.

Among other discussers were E. W. Upham, Chrysler Corp.; Clinton Brettell, R. H. Macy & Co., Inc.; M. B. Chittick, Pure Oil Co.; and G. L. Neely, Standard Oil Co. of Calif.

European Aviation Engines

By Arthur Nutt

Vice-President in Charge of Engineering
Wright Aeronautical Corp.

WHAT is your opinion of the progress of aviation-engine development in Europe in the past two years? Although an analysis of the progress is difficult after only two months during October and November, 1936, in Germany, Russia, Holland, Switzerland, Italy, France and England; yet, having made a similar trip exactly two years ago, the impressions obtained may help to answer the question. Several opinions regarding the volume of aircraft and engine production in the various European countries have been published recently and, in almost all cases, the figures are probably about twice as large as far as engine production is concerned as they should be, judging from actual observance of production facilities, personnel, and equipment. In spite of this somewhat pessimistic statement the progress in European aviation-engine production has been extraordinary in the last two years.

A discussion of engine types, factories, and equipment in each of the countries visited, perhaps, will be the easiest way to present a picture of the progress of the industry with particular reference to engines.

Germany

Germany at the present time is engaged in manufacturing in production engines which are seven or eight years old in design, the reason being that, with the restrictions which were placed on this country in the past, it has been unable to keep its designs on a par with other countries. Production of available designs permits the Germans to develop their production facilities and to train personnel and, in the meantime, they are bringing along experimental models of advanced design which, it is expected, will be as modern as any of the aircraft engines built in other countries. They are building Junkers Diesel engines of 700 hp., B.M.W.-6 conventional water-cooled twelve-cylinder vee engines of 750 hp., and Pratt and Whitney Hornet 660-hp. engines under license in large quantities.

The Siemens Co., now called the Brandenburgische Motorenwerke (Bramo), is still building in production its nine-cylinder, 22-liter, radial engine of 650-hp. rating as well as a small radial training engine. It has a number of experimental engines coming along which undoubtedly will be in production in an-

[This paper was presented at the National Aeronautic Meeting of the Society, Washington, D. C., Mar. 12, 1937.]

TWO years ago, Arthur Nutt visited the principal aircraft factories of Germany, England, Russia, Italy and France.

A few months ago, he repeated those visits.

This article compares the impressions which he formed on the two trips and concludes with a warning that the United States must take drastic steps in the near future to maintain its position in the aircraft field both from the military and commercial standpoints.

other year, but information on these engines is, of course, confidential.

Argus is a builder at the present time of smaller engines, 150- to 300-hp. class, six-in-line and eight-cylinder vee air-cooled for training purposes. This factory has some of the most modern engine-testing equipment in the world.

Daimler-Benz is in production on a water-cooled twelve-cylinder vee engine which apparently has a rating of 800 hp. The design of this engine is quite conventional with perhaps one exception: the cylinder blocks are attached with ring nuts on the inside of the crankcase on the sleeve extensions. From a stress-distribution standpoint this design is excellent but, from a service standpoint, accessibility is not good.

The majority of the German engines in production are heavy and bulky with the exception of the air-cooled engines which are rated rather low in comparison to American or English engines.

From an engine-design standpoint, the German aviation-engine industry is not very impressive at the present time, but the expansion of factories, laboratories, and equipment is exceedingly impressive. For example, the Junkers factories have about five million sq. ft., approximately one-half of which is allocated to the manufacture of Junkers Diesel engines and the Junkers Jumo-10, water-cooled, inverted vee engines. This factory alone represents more floor space devoted to aviation-engine production than all the airplane-engine factories in the United States put together. The Junkers-Magdeburg factory adds another million sq. ft., and it is estimated that the B.M.W. factory including the Munich plant and another factory in Germany for manufacturing Hornets, probably have another two and one-half million sq. ft. of floor space. Add about three to four million sq. ft. to these figures for Daimler-Benz, Mercedes-Benz, Argus, and Brandenburgische, and it appears then that Germany has eight or ten million sq. ft. of floor space for the production of aircraft engines at the present time. Expansion of this industry has taken place for the most part in the last two years, so that all the equipment for production and research is the most modern that can be procured.

The new Junkers single-story factory at Köthen for the manufacture of Diesel engines is one of the most modern factories in existence. It is laid out with ample room between machines for unfinished and finished material, has very wide aisles, individual-motor-driven machinery, and production undoubtedly could be expanded to three or four times its present volume.

Apprenticeship systems are in very great evidence throughout all the German factories which is a very wise and necessary procedure.

Two German aircraft factories – one in Berlin, the Henschel factory, and the other at Rostock, the Heinkel factory – were visited. The Henschel factory is of modern design; the departments are segregated in a number of small buildings, rather than in one large building, on account of the danger from aerial attack. As you probably have read in current periodicals, this factory as well as many factories in Germany is equipped with underground bomb-proof rooms for the workers, each worker being assigned to a certain station at which station will be found a gas mask for his protection. This exhibit is rather gruesome but particularly impressive since we are not in the habit of thinking along the lines of protection against aerial attack as they are in Europe.

The trip from Berlin to Rostock to visit the Heinkel airplane factory was made in a Junkers-52 three-engined Army bombardment airplane. The flight was made at very low altitude under a low ceiling of broken clouds and the air was exceedingly rough, but the Junkers-52 flapped its wings all the way, apparently enjoying the rough air. The ship, on account of its flexible wings, takes the "bumps" better than most airplanes. The noise level in the cabin was very high, there being no attempt at sound-proofing as there is in the transport model of this ship, and it reminded one of the three-engined Ford airplane days plus 50 per cent more power to make noise.

The Heinkel factory also is constructed in typical German or European style with a number of small buildings. The impressive part of this factory was the tremendous size of the engineering department with about 800 drafting boards, all of which were occupied. If the American practice of using horizontal drafting boards were used at Heinkel's, two or three times as much floor space would be required. Heinkel is producing in quantity the single-engined Model 70 with a wooden wing, and the two-engined all-metal Model 111 airplane, the latter being similar to the Junkers JU-86 and the Lockheed Electra in size and general design.

Russia

Russia always is considered to be one of the most interesting countries to visit partially because little is known about it, but also because it is new industrially. A week in Russia is too short a time to form any opinion regarding the progress of its aviation industry as a whole as the country is too large for any person to attempt such an analysis in that time.

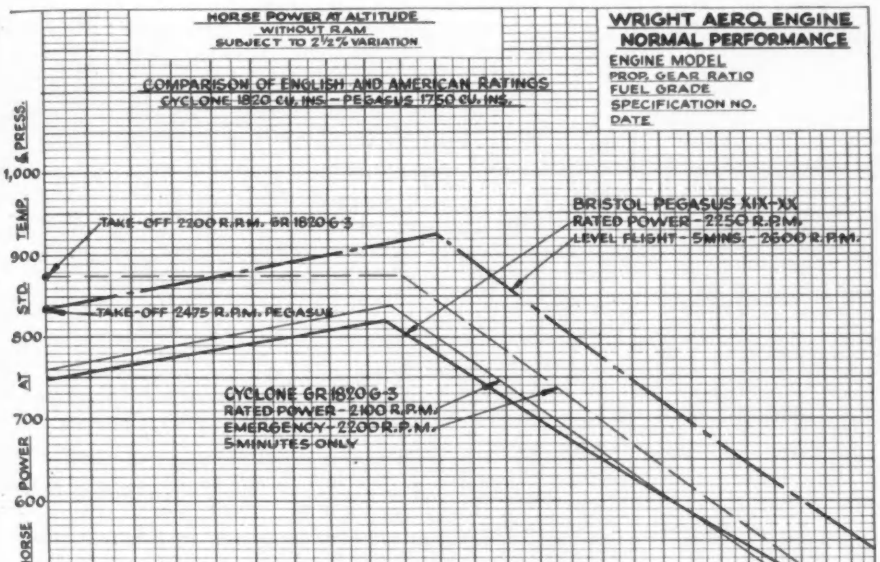
A comparison of conditions in several factories now, with those observed in 1934 during a previous visit, may serve to indicate the progress which has been made.

Two engine factories were inspected, one in Moscow and the other in Perm, the latter being devoted to the construction of Wright Cyclone engines. The factory at Moscow is about twice as large as either the Pratt and Whitney or the Wright Aeronautical factories. It is devoted to the construction of 1000-hp. twelve-cylinder vee water-cooled aircraft engines. The design of this engine is quite conventional, and apparently the engine is doing a good job in service in spite of the fact that it is somewhat heavy. Regarding the quality of the work which is being produced in this factory, the improvement which has been made in the past two years was very noticeable.

As evidence that human nature is much alike the world over, it was interesting to note that inspection control in this factory works exactly the same as in any other factory and, even though the Russians are building these engines for themselves in government factories with their own government inspectors, the same problems of quality control are present. Many unnecessary operations are performed on the engines in order to satisfy the inspection department, some of them being actually a detriment as far as quality is concerned but are performed only to improve appearance. Polishing of cylinder bores was being done with a felt wheel, undoubtedly destroying the accuracy of the surface which must be free of hollows to obtain proper oil control. Many parts such as gear teeth were being polished after preliminary test with deformation of the surfaces of the tooth faces. Experience eventually will dictate changes in these practices. Particular attention has been paid in the last two years to the improvement in the outside appearance of the engine which is a desirable feature as it promotes better care of the engine in service.

The factory for building Cyclone engines is located about 900 miles east of Moscow and was built on a site on the outskirts of a town where there apparently has never been any previous industrial activity. In about three years' time this factory has been developed from bare land to a plant about twice the size of the present Wright factory, completely equipped with the most modern machine tools, laboratory equipment, and a foundry. Schools, apartments, nurseries, kindergartens, and recreation buildings were included in this project.

The problem of engine production in Russia is far greater than in almost any other country because of the lack of ade-



Arthur Nutt

European aircraft engines may only appear to be more efficient than American, Mr. Nutt explains, due to the use in England of emergency or military ratings which employ considerably greater power for a much shorter time. Typical British and American engines, both rated on the American basis, indicate the American engine superior. When both are rated on the British basis, the British engines seem to be superior.

This point is illustrated graphically in the accompanying chart.

quate transportation facilities and non-existence of many companies for supplying small tools, perishable tools, and many small commercial parts which can be procured usually from outside sources. For example, the foundry must make its own flasks, molder's tools, vises, and similar equipment since there are no sources of supply for this material as yet in Russia.

In spite of these handicaps the Russians are producing Cyclone engines in fair quantities and of satisfactory quality. There seems to be a tendency in Russia to adopt the system used in other countries of having experimental engine development conducted in each of the engine plants rather than in a central laboratory as was the case two years ago. This system is similar to that used in this country and more advance can be expected under it than under their old system.

In spite of the fact that gasoline supply should not be a problem in Russia, considerable four-cycle Diesel-engine development has taken place in recent years. It would seem that concentration on fuel development on account of their vast supply of good crudes would be wiser at the present time rather than devoting energies to Diesel-engine development.

Every engine factory is equipped with the most modern laboratories – metallurgical, chemical, and physical – and, in spite of the shortage of personnel familiar with all these instruments, considerable progress is being made along the lines of research. Undoubtedly the result of having such fine equipment will be reflected in their product as their development work progresses.

All factories in Russia have about twice as many workmen per unit of manufacture as are found in the United States, but this condition is not peculiar to Russia as it exists in many other countries, the purpose being to train men for the expansion programs which they all have.

Italy

Italy also has a large expansion program. Although time was not available to visit the Fiat factory, it is understood that it is in large production on Pratt and Whitney Hornet engines as well as liquid-cooled engines of its own design. Alfa-Romeo is producing the Bristol Pegasus engine in a factory with about one million sq. ft. of floor space, and the Isotta-Fraschini factory, which is about the same size as Alfa-Romeo, is producing the same line of water-cooled vee twelve-cylinder engines that it was producing two years ago. This engine is fairly light in weight owing to the fact that the crankcase and many other parts are made of magnesium alloys. The quality of material and workmanship in these factories was not impressive which is probably the result of a shortage of trained personnel and of the difficulty in getting high-quality raw materials. Italy also has too many workmen per-unit-produced because of the personnel situation and superfluous hand-operations in production.

France

France has not made the progress in the last two years made by other European countries. The political unrest and the labor disturbances which have been present during the past two years are largely responsible for this situation. France probably holds the championship on the number of sit-down strikes which have brought about a complete reorganization of the whole industry and the results, as far as production is concerned, are not encouraging. The government is taking over the management of the aircraft industry completely, and as rapidly as possible. The effect of this change will not be known for some time, but the wisdom of such a move is questionable. Production has dropped off to about 50 per cent in the past year because of the fact that the men are not producing as much work per hour as they did under the old system be-

cause of labor disturbances and the reorganization program. The advance in research has suffered accordingly, and the only new models of the two large manufacturers which have appeared during the past two years which are interesting are the Gnome-Rhone fourteen-cylinder and eighteen-cylinder engines of 642 hp. and 1280 hp., respectively. The smaller engine is only 37 in. in diameter and will be a very difficult development as the engine is cramped in design in an attempt to reduce its size. The larger engine is 55½ in. in diameter and compares favorably in this respect with American engines. Considerable development work will be necessary before these models will be satisfactory service types.

Little change, except a slight increase in power, was seen in the Hispano models which include its cleverly designed liquid-cooled twelve-cylinder vee engines and the modified Cyclone and Whirlwind engines built under license. Its two fourteen-cylinder engines, developed from the Wright Whirlwind and Cyclone engines, develop 740 hp. and 1105 hp. respectively. These engines are both unusually small in outside diameter.

Both Gnome-Rhone and Hispano two-row engines use no center main bearing, differing radically in this respect from American practice. Hispano has applied two damper weights in one counterweight of its two-row engines with fore and aft motion to counteract the bending of the crankshaft owing to the lack of a center main bearing. Clever damper weights also are applied to the in-line engines to remove the 2½ and 3d order vibrations. A large wind tunnel for checking complete engine installations is now under construction at the Hispano factory and will be a valuable addition to its research laboratories. Hispano is a firm believer in the future of liquid-cooled engines, and expects to obtain useful information from the new wind tunnel on cooling of these engines.

England

Although England started on her expansion program somewhat later than the other countries, nevertheless the progress in that country in the past two years also has been phenomenal. Several factories have at least doubled in floor space, although no figures were quoted. Production has increased although quantities last December were not as great by any means as in some of the other European countries.

England has considerable advantage in having available some of the most modern aircraft engines in the world as can be seen from the performance figures obtained in their military aircraft with both the Rolls-Royce and Bristol engines. The English appear to have several military aircraft which are making speeds between 300 and 350 m.p.h. at 15,000 ft. altitude.

Rolls-Royce is producing in large quantities its Merlin engine, a twelve-cylinder vee, rather conventional in design but with phenomenal performance. The Merlin delivers 1050 hp. at 16,000 ft. with a single-speed supercharger, a performance probably superior to any aircraft engine of equal displacement in production. Much of this extraordinary power at such a high altitude can be attributed to the use of very high engine speed and the English 5-min. military rating which gives their engines a 15 per cent advantage over those rated in the usual manner. Rolls-Royce claims with considerable justification that, where very high speeds are needed for military ships, the smaller frontal area and lower skin friction offered by the in-line engine is worth 4 or 5 per cent in speed at velocities of 350 to 400 m.p.h. The same engine used for commercial air transport operation must face the handicap of a cast crankcase, higher heat loss to the oil, the pains of lead attack on valves (the elimination of which is more difficult than in a two-valve air-cooled cylinder), and the main-bearing problem. Although the initial expense of the engine should not influence the purchaser if he can buy longer life; yet the liquid-cooled engine must overcome the handicap of the added initial and maintenance costs of the cooling system. No transport operator, except the Junkers Diesel operators, have considered the use of liquid-cooled engines seriously in recent years, and probably would use air-cooled Junkers Diesels if they were available.

The expansion which has taken place at both Bristol and Rolls-Royce for production purposes is remarkable. Although figures on production were not available, nevertheless it is understood that English aircraft-engine factories have about five times as many engines on their books as we have now. Time did not permit inspection of the production factories at Rolls-Royce, but the new Bristol plants were very impressive. The Pegasus and Mercury engines, 1010 hp. and 850 hp. maximum respectively, are their large-production models and compare in performance with American engines with an advantage in specific weight because of their smaller displacement, higher engine speed, and the use of military ratings. Everyone is, perhaps, wondering why we do not use military ratings in this country, and this subject will be mentioned further a little later.

Perhaps the most outstanding development today in Europe, and in fact in the whole aviation-engine industry, is the sleeve-valve aircraft engine developed at Bristol by A. H. R. Fedden who will go down in history as the greatest pioneer of this type of engine in the aircraft field. Several air-cooled sleeve-valve radial engines are being built by Bristol in production quantities: the 500-hp. nine-cylinder Aquila, the nine-cylinder Perseus, and the fourteen-cylinder Hercules which uses Perseus cylinders. From the number of engine models available and the production program under way, it is apparent that Bristol is sold thoroughly on the sleeve-valve engine.

Armstrong-Siddeley is continuing the manufacture of its seven-cylinder and fourteen-cylinder radial engines of rather obsolescent design. Expansion has not been as extensive in this plant as it has been undergoing reorganization difficulties, including a plan to separate automobile and aircraft-engine production. Experimental models are in the development stage so that a change in their product no doubt will be seen shortly.

Napier acquired the Junkers Diesel license about three years ago, and no doubt has regretted it ever since judging from the lack of business from this model. They are producing Major Halford's "H" engine with two crankshafts and twenty-four cylinders. This type is both expensive and heavy.

Production

The general impression was obtained that all of these countries will soon be in the state of overproduction. It does not seem reasonable that they can keep on increasing their rate of production without reaching such a condition, but it is possible that national emergencies automatically will take care of the situation. The overproduction also may saturate the export market and retard engine development in the future as no company can afford to spend money continuously on engineering research if sales are low. Factories which have been built for production of aircraft engines may be diverted to other products whenever sufficient engines have been produced to meet their program, but such a change is difficult to control and one wonders what the outcome will be in three or four years' time.

Production efficiency appears to be lower in all European countries, this impression being obtained from the large number of men at each factory required to produce a certain number of engines. As previously stated, this condition has been created partially by the system of putting a large number of men in a factory in order to teach them trades so that their expansion program can proceed. However, contrary to statements which have been published in articles recently on production efficiency in European engine factories, a great deal of hand work is done on European engines which ac-

counts for some of the extra men required in these factories. A statement has been made that the Germans, for example, put every operation possible on machines but evidence of this fact was not seen. Actually they were doing many operations by hand which we would do by machinery. This condition will no doubt be corrected as production operations are refined.

Engine Types and Ratings

There is a definite trend in Europe towards air-cooling. Practically every manufacturer building liquid-cooled engines is experimenting or is in production with air-cooled engines, and no manufacturer of air-cooled engines appears to be experimenting with liquid-cooled engines. This trend, however, is not a good excuse for dropping the development of liquid-cooled engines, and many of the companies who build both types are fully aware of this condition and are not dropping their liquid-cooled development.

In further reference to emergency or military ratings for engines, there is a practice in some of the European countries of using very high power for a short period of time with the result that their engines appear to be more efficient than American engines. This 5-min. emergency operation at about 15 per cent greater power than the rated power is very useful in military aircraft, producing high airplane speeds. In spite of whether it is correct, airplane speed is the one characteristic which has more to do with the sale of military aircraft than any other performance characteristic, and naturally the military authorities in other countries are considerably disturbed that their own engines do not produce similar results.

English engines would not receive as high a rating in this country under the American type test as they do under the English type-test conditions, and their engines are, therefore, lighter per horse power on account of the less strenuous type-test conditions. French engines are even lighter than British engines because of the fact that their type test is less than half as difficult as the English type tests. Reliability and durability are sacrificed by the use of such testing standards, and a gradual increase in severity of European type tests has been evident and will be seen in the future.

A great difference in the method of government type testing of engines was noted in Europe. The type test for approval of both types and models very often is conducted in the engine manufacturers' plants, thereby leaving the government laboratories free to do special testing and research on problems of use to the whole aircraft-engine industry. This practice, if followed in this country, would accelerate the progress of engine development and tend to simplify one of our most difficult procurement situations. All tests are, of course, conducted under government inspection.

Sleeve-Valve Engine Development

Sleeve-valve engine development in Europe seems to be concentrated in England. The Bristol Co. is in production with sleeve-valve engines, and other manufacturers in England are experimenting with this design. According to reports from England, the sleeve-valve engine has some advantages over the poppet-valve engine, it being claimed that the engine is cheaper to produce and does not suffer from the use of tetraethyl lead in the fuel. In defense of the modern air-cooled poppet-valve aircraft engines, they are being operated on fuel with high lead content successfully so that this advantage is questionable. It is also claimed that the sleeve-valve engine can use a slightly higher compression ratio with the same fuel which is an advantage from a fuel-consumption standpoint. Although the use of higher engine speeds is claimed to be possible, actual operation at higher speeds than the poppet-valve engine has not been demonstrated commercially as yet; nevertheless the claim seems reasonable.

Diesel Engines

The Russians are doing some development work on Diesel engines, but Diesel-engine development seems to be concentrated in Germany on account of the difficulty in getting a sufficient quantity of satisfactory gasoline. The latest development in Diesel engines in Germany is the Junkers 205D 700-hp. six-cylinder water-cooled engine which weighs, without water and radiator, 1.63 lb. per normal rated hp., which actually means 2.2 lb. per hp. in comparison with an air-cooled engine of similar size which weighs 1.4 lb. per rated hp. complete. In other words, there is a handicap at the present time of nearly 0.8 lb. per hp. to be overcome by the Diesel engine. The German Diesel engines apparently can cruise at about 0.03 lb. per b.hp.-hr. fuel consumption less than the gasoline engine, judging from the recent transatlantic flights, which means a saving of 600 lb. in a 20-hr. flight when cruising at 500 hp. per engine in a two-engined airplane, but 0.8 lb. per hp. on a 1400-hp. airplane means 1120 lb. additional engine weight. With this handicap in weight and since most flights are shorter than 20 hr., the value of Diesel engines must be considered very carefully on a payload basis before entering into an expensive engine development program. As engine powers increase, the Diesel engine may become more attractive but at present it lacks high take-off power and power at altitude, although these deficiencies can be removed by the use of the exhaust turbine supercharger. The price of fuel in this country at the present time does not warrant Diesel engine development, and the prices of Diesel fuel and gasoline will come closer together as the use of the Diesel engine is increased. Both France and England appear to have lost interest in Diesel engine development in the last two years. The Diesel engine proponents' favorite argument is the reduction in fire hazard which, with the type of fuel used flashing between 110 deg. fahr. and 150 deg. fahr., is rather poor logic. Many engineers believe that fire hazard from Diesel fuels may be more serious than with gasoline which evaporates when hitting hot surfaces rather than adhering and burning.

Fuel Injection

There is a tendency in Europe to develop gasoline fuel-injection systems, the reason being advanced that fuel injection should make the problem of gasoline distribution on large multicylinder engines easier than can be accomplished with a carburetor, but it must be remembered that air distribution is not easy either. The development of non-icing carburetors in both this country and Europe, of course, has eliminated the necessity of developing fuel injection for the purpose of eliminating ice. Fuel injection may be used in the future, but there appear to be no gasoline engines in Europe using this device in production at the present time.

Superchargers

In Europe supercharging seems to be on a par with the progress of this development in this country, and in some cases superior. The performance of the Rolls-Royce Merlin engine indicates that the efficiency of its supercharger must be as good or better than our superchargers, or that the engine is able to operate with higher intake mixture temperatures than are American engines. The latter reason is a big factor because the engine is liquid-cooled and is running at high speed with a low mean effective pressure as compared to American engines and, therefore, may be able to use the higher intake mixture temperatures.

Research Laboratories

Europe is definitely leading this country as far as laboratory equipment is concerned. Laboratories under construc-

tion in Europe are exemplified by the D. V. L. Laboratories in Berlin which are equipped with the most modern aerodynamic and engine-testing equipment. One of the latest additions to the D. V. L. Laboratories is the altitude chamber for testing aircraft engines which will handle both air-cooled and liquid-cooled engines of very high power. This laboratory also is equipped with a small separate laboratory for supercharging single-cylinder engines at high altitude.

Unfortunately there are only two altitude engine laboratories in this country, and they are used at present for routine engine testing mostly, thereby handicapping this country in its development of altitude engines because no engine manufacturer under the present system can afford to build such expensive laboratories.

Fuels and Oils

Fuel development in Europe does not appear to be advancing as rapidly as it is in this country, particularly as far as the production of high-octane fuel is concerned. Most of their engines are built to run at higher speeds and lower mean effective pressures and, therefore, can operate on fuels of lower octane rating. This trend in development, of course, is dictated by the fact that gasoline and high-octane fuels are far more expensive in Europe than they are in this country.

Lubricating oil development seems to be on a par with the development of oils in this country.

Materials

On the subject of materials, the most outstanding development in Europe is the extensive use of magnesium in cast, sheet, and forged forms. Many aircraft engines in Europe use magnesium castings which are highly stressed, which is a practice avoided by engine manufacturers in this country. New magnesium alloys that are not alloyed with aluminum are being developed and appear to have considerable promise, particularly as far as strength at high temperature is concerned. They may be useful for pistons, cylinder-heads, crankcases, and other highly stressed parts.

The development of materials in the aircraft industry in general is not as progressive as it should be, but the Europeans are doing more work along this line than we are.

Single-Cylinder Test Engines

One of the most impressive practices in Europe is the extensive use of the single-cylinder test engine for the development of cylinders, pistons, piston-rings, and the study of combustion. Almost every aircraft engine manufacturer and government laboratory has a large number of single-cylinder engines working continuously on development work, a practice which we might well follow in this country to a greater degree than we are doing at present.

Visitors

The warm reception given to visitors by all the factories was very noticeable and also embarrassing in view of the restrictions which are placed on many aircraft factories in this country. There is an impression in this country that we do not gain by permitting foreign visitors to go through our factories but, with the intensive development in factory and laboratory equipment in Europe, many engineers in this country will be looking to the Europeans for advance information.

Conclusions

In conclusion, a rather pessimistic impression may be left as to the relative progress in this country of the aircraft engine industry and, although it is difficult to compare conditions in this country directly with those in Europe where political and international affairs are so different, yet the situation requires thorough consideration. Those of you who were acquainted intimately with the airplane and engine production fiasco in this country during the World War realize the importance of doing a lot better job of preparing for emergencies than was done at that time, and a few pages from the book of European experience and practice would not be unwise. There is a tendency in this country to believe, and with considerable justification, that we are further advanced than our European neighbors in aircraft and aircraft engine development which may have been the case in general up to the present time but, with the tremendous amount of money being poured into production and research facilities in Europe, the result is certain to be toward the production of superior equipment, and this country will be forced to take drastic steps in the near future if it expects to maintain a satisfactory position in the industry from both a commercial and military standpoint. This opinion is not shared by many in this country, but one has only to observe the high performance of foreign military aircraft, the expansion in laboratories and production facilities, to realize the relative rate of development of European and American aircraft and aircraft engines.

Factors Influencing Aircraft-Engine Development in France

SINCE the War, and up until two or three years ago, there has been little difference in basic aircraft design and manufacture throughout the world.

Due to many world conditions this situation is beginning to change. Until recently production of aircraft engines never has been great enough to warrant the design of purely military types and civilian types in the higher power brackets. There always has been a compromise, and countries where commercial aviation dominates tend to adapt commercial engines to military aircraft and vice-versa. In many cases, the same engines which power long-distance, weight-carrying passenger liners are used to drive bombers, observation, and pursuit-type military airplanes. With advances in bombers and passenger liners, these heavy machines often can outdistance the pursuit planes which were supposed to protect them.

In the United States we found this condition a little disconcerting but not critical as we have natural barriers against the bombers of today, very friendly neighbors, and vast stores of petroleum. However to France, a small country surrounded by none-too-friendly neighbors and with her industries concentrated in centers within one to two hours' bombing distances of enemy air fleets, this condition meant an immediate threat in the event of war unless she had fighting fleets fast enough to drive off enemy bombers or to protect her own bombers in reprisal attacks. Furthermore, France cannot accomplish this preparation by simply boosting the power of the engines in her aircraft as she has no native petroleum and her liquid fuel supply, save for a small quantity of benzol and alcohol, can be shut off by an effective blockade or by neutrality laws in petroleum-producing countries classing the liquid fuel, which is the life-blood of every war, as contraband. France, therefore, has to conserve her fuel supply with the greatest care.

Thus, while we may continue to design engines primarily suited to commercial aircraft, the French have been forced to develop a new specialized technique. It now seems that these specialized powerplants will boost military aircraft performance to the point where we must follow or drop back in the procession which we have certainly led for the past few years.

Excerpt from the paper, "Design Trends in French Aircraft Engines and Propellers," by Henry Lowe Brownback, presented at the National Aeronautic Meeting of the Society, Washington, D. C., March 12, 1937.

About SAE Members:
. . . . At Home and Abroad

Byron C. Foy, president of DeSoto, has been appointed chairman of the show committee in charge of the National Automobile Show to be held in Grand Central Palace, New York, Oct. 27 to Nov. 3.

Alfred C. Davis has been made president of the Marlin-Rockwell Corp., succeeding Henry K. Smith, who was elected chairman of the board. Mr. Davis was formerly vice-president. *F. W. Gurney,* who had been chairman, resigned.

Charles L. Drake is now in the Chicago office of New Departure Manufacturing Co., as sales engineer. He was formerly sales engineer in the Chicago office of the Fafnir Bearing Co.

Edsel B. Ford recently was elected to the board of directors of the American I. G. Chemical Corp.

Rear-Admiral Emory Scott Land has been made commissioner on the United States Maritime Commission, Washington. He previously held the post of chief constructor, Bu-

E. S. Land
Commissioner

reau of Construction and Repair, United States Navy. Admiral Land recently has completed a three-year term as an SAE representative on the Guggenheim Medal Board of Judges.

C. M. Young has been advanced to the presidency of the L. A. Young Spring & Wire Corp., Detroit. *L. A. Young,* who formerly held this position, continues with the company as chairman of the board. The new president, formerly vice-president and treasurer, is 30 years old and said to be the youngest top executive in the automotive field. *T. D. Stewart,* director of sales for the company, has been made a member of the board.

Tenth Degree to Kettering

Charles F. Kettering received his tenth honorary degree on June 9 when New York University conferred upon him the degree of Doctor of Science. Other colleges and universities that have honored him with the Doctor of Science degree are University of Cincinnati (1928), Brown University (1932), Toledo University (1934), Northwestern University (1935), and Lafayette College (1936). He received the degree of Doctor of Engineering from University of Michigan, his Alma Mater, and from Ohio State University in 1929; from Polytechnic Institute of Brooklyn in 1930; and the University of Detroit in 1934.

Richard C. Gazley, formerly chief engineer of the Bureau of Air Commerce, has been appointed to the new position of chief, safety and planning division of the Bureau. In this position Mr. Gazley will have for his duties the supervision of seven sections engaged in development and promotional work, including studies to be made for all other sections of the Bureau and studies with relation to airline activities, aircraft and powerplants, instruments and like subjects. He first joined the

Photo by Harris & Ewing

Richard Gazley
Heads Division

Bureau in 1927, leaving after two years to engage in the practice of consulting engineer. In 1930 he returned as chief, engineering section.

Henry Ford, Ford Motor Co., was presented with the Holley Medal by the American Society of Mechanical Engineers "for his revolutionary influence through invention and practice on transportation and mass production methods in manufacture." The presentation was made by ASME President James H. Herron during the Society's semi-annual meeting, May 17-19.

Grover Loening has been elected chairman of the executive committee, Roosevelt Field, Inc.

M. Goldschmidt
General Manager

M. Goldschmidt is general manager of Metalastik Ltd., Leicester, England.

Alfred P. Sloan, Jr., chairman of the board, General Motors Corp., has been elected first vice-president of the Automobile Manufacturers Association, and GMC's president, *William S. Knudsen* has been elected to the board of directors of the Association. Other officers of the organization were re-elected for additional terms.

Edward Albert Chapin has joined the engineering staff, Diesel division, General Motors Corp., Detroit. He was previously test engineer, research department, Continental Motors Corp.

Charles S. Mott, vice-president of General Motors Corp., received an honorary Doctor of Engineering degree from the Stevens Institute of Technology on June 12.

(Continued on next page)

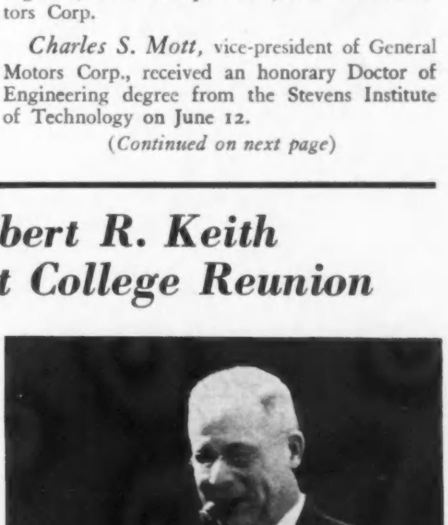
Vice-President Robert R. Keith Dies While at College Reunion

Robert R. Keith, SAE vice-president representing the Production Engineering Activity, died suddenly on June 12 while attending the 35th reunion of his class at Iowa State College.

Mr. Keith, who was general works manager of the J. I. Case Co., Racine, Wis., had been prominent in the activities of the Society since election to membership in 1922. Last year he was a member of the Production Activity Committee and prior to that he served on the National Meetings Committee and the Production, Truck and Engine Divisions of the Standards Committee. Not long before his death Mr. Keith met in Flint, Mich., with other members of the Production Committee to make preliminary arrangements for the SAE Production Meeting to be held there in December.

Before joining the Case company in 1929 Mr. Keith was with the International Harvester Co. for eight years, in charge of truck, coach and all automotive engineering. In earlier years he was affiliated with the Moline Plow Co., the Holt Co. and Fairbanks, Morse & Co.

Born in West Liberty, Iowa, in 1879, Mr. Keith attended high school in Des Moines and continued his education at Iowa State College



R. R. Keith

from which he was graduated with a B.S. degree in M.E., in 1902.

Mr. Keith is survived by his wife, Helen Marks Keith, two daughters and two sons.

William S. Knudsen, president of General Motors, has established a fund of $250,000 to provide for maternal and infant care in the city of Flint. This will be known as the Clara Elizabeth fund in honor of his wife.

Dr. F. C. Reggio recently resigned his position as director, research laboratories, Compagnie Lilloise de Moteurs, Seine, France. He is now visiting the United States. Mail addressed to SAE headquarters will be forwarded to him.

Thomas A. Scanlan has joined the staff of Corbin Cabinet Lock Co., New Britain, Conn., as sales engineer.

Ralph M. McGee recently became affiliated with the Skelly Oil Co., as assistant manager, Denver. He previously was city manager for Phillips Petroleum Co., Bartlesville, Okla.

Paul G. Hoffman, President, Studebaker Corp., last month received an honorary degree of Doctor of Laws from Rose Polytechnic Institute at Terre Haute, Ind. Delivering the commencement address to the RPI graduating class, Mr. Hoffman urged the development of

Paul G. Hoffman
Honored

individuality and resistance to influences toward uniformity and mediocrity.

Last month also, Mr. Hoffman was elected president of the newly formed Automotive Safety Foundation. (Story on p. 26.)

James G. Young, former general manager of Sanderson Brothers & Newbould, Ltd., Sheffield, England, has been named general manager of the Climax Rock Drill & Engineering Works, Ltd., Carn Brea, Cornwall.

Frank Caldwell, engineering manager, Hamilton Standard Propellers, was one of the American experts to take part in the investigation of the destruction of the German airship *Hindenburg.*

Erik Oberg, editor of *Machinery,* sailed on the S.S. Gripsholm early in June to attend the 50th anniversary of his alma mater, the Boras Technical College, Boras, Sweden. Mr. Oberg graduated in 1900 and came to the United States the following year.

Chrysler Promotes

David A. Wallace has been named president of the Chrysler Division of Chrysler Corp. He was, for many years, vice-president in charge of manufacturing at the Jefferson and Kercheval plants and president of the Chrysler Marine Engine Division. Mr. Wallace joined Chrysler in 1929 as staff master mechanic.

Joseph W. Frazer, who has been vice-president of the Chrysler Division, has become vice-president and director of sales and merchandising of this division. He was in the sales department of Chrysler Corp. in 1924, when its first cars were produced, and was made general sales manager the following year.

P. G. Fitzpatrick, formerly with the Four Wheel Drive Auto Co., has established the Fitzpatrick Thornton Tandem Fleet Sales Co., with headquarters in New York.

William B. Mayo has become consulting engineer for Hupp Motor Car Co. This follows five years of partial retirement from the auto-

William B. Mayo
With Hupp

mobile field, preceding which he was for 19 years engineer and chief engineer of the Ford Motor Co.

William A. Irvin, president of U. S. Steel, formally broke the ground for Carnegie-Illinois Steel Corp.'s new sheet, strip and tin plate mill which will bear his name. The ceremony took place May 22.

Alfred Reeves, vice-president of the Automobile Manufacturers Association, sailed for Europe the middle of last month. While abroad he is addressing the International Chamber of Commerce at Berlin on "Financing the Highways," and studying the motor-vehicle trade in Europe, including highway construction, tariffs, international problems of market expansion and use of cars and trucks.

J. L. Dilworth, formerly assistant supervisor of automotive equipment, Virginia Electric and Power Co., has joined the research department of Packard Motor Car Co., at Detroit.

C. A. Musselman, president, Chilton Co., Philadelphia, was elected to the board of the Associated Business Papers at its spring conference, May 20-22.

Harry H. Kerr, president, Boston Gear Works, was elected president of the American Gear Manufacturers Association at its 21st annual meeting, Wernersville, Pa., May 24-25. *Howard Dingle,* president, Cleveland Worm & Gear Co., was elected vice-president. During the meeting Mr. Kerr presented a paper on "Wage Incentives."

Julius P. Heil, president and treasurer of the Heil Co., Milwaukee, has been elected president of the Jambor Tool & Stamping Co., also of Milwaukee.

Donald H. Spicer, formerly sales manager of Atlas Asbestos Co., North Wales, Pa., has been appointed assistant manager, replacement division, Asbestos Manufacturing Co., Huntington, Ind.

Harte Cooke, engineer, McIntosh & Seymour Corp., has been nominated as a vice-president of the American Society of Mechanical Engineers.

A. H. Timmerman, vice-president, Wagner Electric Corp., St. Louis, was elected second vice-president and treasurer of the National Metal Trades Association at the 39th annual convention of that organization, May 27-28. *Harry H. Kerr* was elected councilor to serve two years.

Dr. George W. Lewis, director, aeronautical research, National Advisory Committee for Aeronautics, was a passenger on the Bermuda Clipper on its final inspection trip, June 12, over the 773-mile route to Bermuda.

H. C. Mougey, chief chemist and assistant technical director, research laboratories division, G.M.C., has been elected to the executive committee of the American Society for Testing Materials.

Howard E. Coffin, chairman of the board, Southeastern Cottons, Inc., and long associated with the automotive industry, married Miss Gladys Baker, a Southern writer, on June 1. Mr. and Mrs. Coffin will reside at One Fifth Ave., New York.

Inspecting 1000-Hp. Engine

***O. T. Kreusser,* general manager, *left,* and *Ronald M. Hazen,* chief engineer, Allison Engineering Division, G.M.C., pictured with the new 1000-hp. Allison 1710 chemically-cooled aircraft engine which both had part in developing.**

W. J. Davidson, director, technical division, General Motors Corp. and chairman of the SAE Engineering Relations Committee, has been appointed by the Council to represent the Society on the Advisory Committee of the Highway Research Board of the National Research Council.

Bertrand L. Wyborny is owner and manager of the Burlington Loan Co., Burlington, Iowa. He was previously vice-president of the Fair Price Petroleum Co., Yankton, S. D.

William Harrigan, engineer of the Texas Co., is directing the Texaco national road test fleet which will use 25,000 miles of American highway as a laboratory for technical research. The fleet left Detroit May 15 and will visit every state in the Union.

A. L. Martinek has been appointed chief engineer of the Delta Electric Co., Marion, Ind. He was formerly electrical and illuminating engineer with the H. A. Douglas Manufacturing Co., Bronson, Mich.

W. C. Leingang has been appointed manager, automotive manufacturers' sales, by the Electric Storage Battery Co., Philadelphia, manufacturers of Exide batteries. Entering the employ of the Detroit branch of the company in 1923 he was transferred to the home office in Philadelphia in 1935. Mr. Leingang graduated in electrical engineering from the University of Michigan in the class of '23.

W. C. Leingang
Promoted

Charles J. Manney joined the Seagrave Corp., Columbus, Ohio, as mechanical engineer early in June. He was previously instructor in mechanical engineering, Tulane University. While at Tulane he was active in fostering student membership in the Society. Mr. Manney was recently honor guest at the University's Glider Club banquet, at which he was presented with a model glider.

Herbert Hosking, editor, *Automotive Industries,* Philadelphia, has been re-elected an honorary vice-president of the American Institute of Graphic Arts.

E. L. Ludvigsen has been appointed vice-president and general manager of the Fuller Manufacturing Co., Kalamazoo, Mich. He had been vice-president in charge of sales.

On A.S.T.M. Program

Six SAE members are taking part in the 40th annual meeting of the American Society for Testing Materials, New York, June 28 to July 2. K. G. Mackenzie, The Texas Co., is chairman of the meeting finance committee, and J. B. Rather, Socony-Vacuum Oil Co., is on the committee on arrangements. Scheduled to take part in the various sessions are: J. C. Geniesse, Atlantic Refining Co.; T. A. Boyd, General Motors Corp.; J. P. Stewart, Socony-Vacuum Oil Co.; and Sam Tour, Lucius Pitkin, Inc.

SAE Past-President Writes On Mechanics of Prosperity

Dr. H. C. Dickinson, chief, heat and power division, National Bureau of Standards and president of the SAE in 1933, is author of "The Mechanics of Prosperity," recently published by The Williams & Wilkins Co., Baltimore.

This book extends and clears up a number of the ideas expressed by Dr. Dickinson in his address made before many of the Society's Sections on his Western trip in 1933.

In the preface he explains, "This volume deals with men en masse and with work and money as seen by a physicist and an engineer. The problem is treated as in the 'exact' sciences, first defining assumptions which appear to be plausible, deducing conclusions to which they must lead, then checking both against facts which are known, until assumptions are found and conclusions are reached which are consistent with each other and with the facts of history."

Photo by Harris & Ewing

Dr. H. C. Dickinson

Maj. Mark V. Brunson, Quartermaster Corps, U. S. Army, now a graduate student at the University of Michigan, has had his second major thesis accepted by the University. The subject is "Warehousing, Storage, Materials Handling Equipment, Packing and Crating, Fire Protection, Management, Financing, Cost Accounting, Internal and External Transportation, Merchandise Warehousing and Handling of Relief Supplies." Major Brunson's next military assignment is the War Plans and Training Division, Office of the Quartermaster General, Washington, D. C., at which station he will report for duty July 15.

Sid G. Harris, past-chairman of the Metropolitan Section, is Eastern representative for Macmillan Petroleum Corp., Los Angeles. He will have headquarters in New York. Mr. Harris was formerly sales engineer for Continental Motors Corp. and Reo Motor Car Co.

O. E. Eggen, chief engineer, Oliver Farm Equipment Co., as chairman of the power machinery division of the American Society of Agricultural Engineers, presided at two of the division's sessions at the Society's 31st annual meeting held at the University of Illinois, June 21-24. *L. B. Sperry,* chief engineer, Gas Power Engineering, International Harvester Co., delivered a paper on "Proposed Standardization of Tractor Fuels" at the June 22 session.

Changes at Houdaille-Hershey

Claire L. Barnes, former president of Houdaille-Hershey Corp., Detroit, has been elected chairman of the board, and *Charles Getler,* who had been vice-president, was named president. Two other SAE members, *Ralph F. Peo* and *Don S. Devor* were named vice-presidents.

Obituaries

Otto C. Rohde

Otto C. Rohde, vice-president and chief engineer of the Champion Spark Plug Co., died June 2 as the result of burns and a fractured skull suffered May 28 in an accident during the driving tests that preceded the Memorial Day automobile race at Indianapolis. A crankshaft broke on one of the cars, causing it to catch fire and skid into the pits striking Mr. Rohde and two other bystanders, one of whom was killed immediately.

Mr. Rohde, who was 49 years old, became a member of the Society in 1917, and was active on the spark plug subdivision, gas engine division, SAE Standards Committee. A graduate of the University of Michigan, class of 1909, he had worked with the Homer Gas Engine Co., Vulcan Steam Shovel Co. and the National Seale Co., before joining the Champion Spark Plug Co. in 1914. He was founder of the Champion 100-Mile-an-Hour Club, composed of drivers who have finished in Indianapolis races at an average speed of 100 m.p.h. or better. Mr. Rohde regularly attended the Memorial Day races.

His wife and daughter survive.

R. M. Heinrichs

Robert M. Heinrichs, vice-president, director and general manager of the Bendix-Westinghouse Automotive Air Brake Co., Pittsburgh, died May 18 as the result of complications following a recent operation for appendicitis. He had been a member of the Society since 1925.

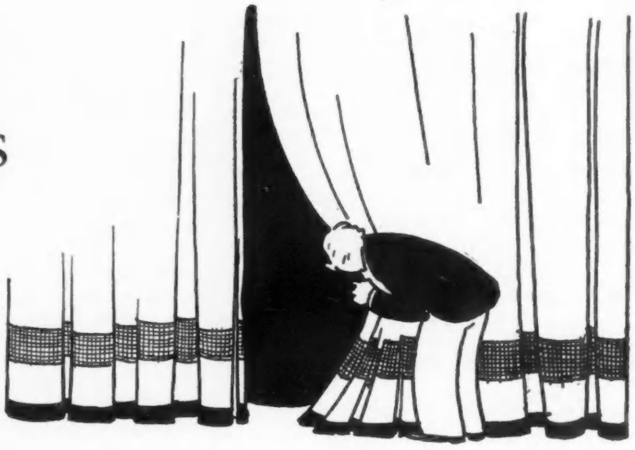
Mr. Heinrichs was born in 1899 at Fort Wayne, Ind. He attended the University of Illinois and was graduated as a mechanical engineer in 1922. In 1925 he entered the employ of the Bendix Aviation Corp. in Chicago and five years later was transferred to Pittsburgh as general manager of the Bendix-Westinghouse Co. He served in that capacity until his recent appointment as vice-president and director was announced.

Mrs. Beulah Brede

Mrs. Beulah Brede, long connected with the Society's Detroit office, died May 19, following a brief illness. Her many friends in the SAE regret her passing.

Behind the Scenes

With the Committees



Action!

● The feasibility of establishing definite voltages for lighting systems on Diesel-powered motor vehicles is being studied at the request of the lamp industry. It is maintained that in present practice too many different voltages are being used, each requiring different lamp equipment. – Standards Committee.

● One-third of the reports of the current oil wear test program have been received and turned over to the Steering Committee for analysis. – Crankcase Oil Oiliness Research.

● The ring-sticking test program of the Crankcase Oil Stability Committee has been revised – it now includes eight test lubricants. Supplies have been located, orders are being received and experimental work will soon be in progress.

● Procedure for operating the SAE E-P lubricants testing machine have been revised. Prepared by a special drafting committee, the revision was approved during the Summer Meeting by the main committee as a tentative standard method. – Extreme Pressure Lubricants.

● A special subdivision is being appointed to make a thorough review of the present SAE spring specifications and prepare a new standard that will be more in line with present-day requirements. The subdivision will be representative of both spring manufacturers and users. – Passenger Car Division, Standards Committee.

● A review of present SAE recommended practice on propeller-shaft mid-ship mountings is underway. No definite recommendation has yet been made but it is indicated that the specification is being widely used. It is probable that the new rubber-mounted type of bearing will be studied from the standardization viewpoint when its use has become more established. – Motor Truck and Motorcoach Division, Standards Committee.

● Work of a subcommittee on method of test for rating road-vehicle spark plugs has progressed sufficiently to justify the exchange of results between cooperating members. – Ignition Research.

● Arrangements have been made for the preparation of a series of articles reviewing and bringing up to date the present status of riding comfort measurement as affected by seat cushions. These articles will cover academic theory, practical requirements of motor car manufacturers and a review of the situation abroad. They will be accompanied by a bibliography. – Riding Comfort Research.

● Plans are in preparation for reviewing both the ball-bearing standards adopted by the Society, as published in the 1937 SAE Handbook, and corresponding American Standards that have been adopted under American Standard Association procedure through the Sectional Committee on Ball and Roller Bearings, sponsored jointly by the SAE and the American Society of Mechanical Engineers.

● An A.S.T.M. subcommittee is cooperating in determining effects of lubricants on bearing metals and data are expected soon. – Lubricants Division, Standards Committee.

● The Electrical Equipment Division is considering the development of a standard method of rating capacities of generators and motors on the basis of wattage. Apparently no generally uniform practice is in use at present, and a standard is said to be desirable in view of increasing load requirements on the equipment. – Standards Committee.

● Working drawings are being prepared for a standard belt-testing machine that can be used by belt manufacturers and users. The Gasoline Engine Division started work on this when the new SAE standard on V-belts and pulleys was adopted (first published in the 1937 SAE Handbook). Until now, it is said, the belt testing situation has been confused. It is expected that this testing apparatus and procedure, as given in the SAE standard, will do much to overcome this condition. The SAE Journal will carry an announcement when these drawings are available. – Standards Committee.

● The recommended procedure for the inspection of the steering mechanism of passenger cars, trucks and buses, revised in accordance with suggestions made by the Front-Wheel Alignment Research Committee, has been circulated for mail ballot. Final action will take place at its next meeting.

Nomenclature

"SUGGESTIONS for Nomenclature for Fuels Combustion Phenomena and Fouling in Internal Combustion Engines," a paper prepared by G. D. Boerlage and C. A. Bouman, and presented at the Second World Petroleum Conference last month, was previewed at a meeting of the Fuels Research Committee during the Summer Meeting. This paper constitutes a proposal for a four-language nomenclature on the subjects indicated.

C. B. Veal, SAE research department, who is a delegate to the World Congress, was instructed to assure the Congress group working on this subject of the committee's desire to cooperate.

The formation of a subcommittee on nomenclature to be composed of engine, carburetor and fuel men was authorized. It will maintain contacts with groups in the National Advisory Committee for Aeronautics and the American Society for Testing Materials which are working on this subject.

Committee Changes

F. S. Spring, Hudson Motor Car Co., succeeds V. P. Rumely as Chairman of the Textile Automotive Group. Mr. Rumely resigned as his change in company connections has taken him from the automotive field.

F. L. Faulkner heads a subdivision to study motor-vehicle design from the operator's point of view. He will devote his time to truck ratings. O. A. Axelson will study lubrication problems, particularly of crankcase oil with regard to oxidation factors; Clinton Brettell, tractor-semi-trailer coupling heights; H. O. Mathews, brakes, and T. C. Smith, lubrication problems with particular reference to extreme-pressure lubricants. – Transportation Division, Standards Committee.

Cancellations Recommended

The tractor division of the Standards Committee recommends that present SAE recommended practices for tractor power take-off and drawbar hitches be cancelled, and that they be replaced with new specifications. When they are worked out by the tractor division the new specifications will be coordinated with those of the American Society of Agricultural Engineers inasmuch as both societies largely represent the same interests in the tractor industry, and these specifications will affect both tractors and agricultural implements operated from them.

The division also recommends the cancellation of the SAE recommended practice for stationary engine belt speeds. Investigation has shown that practically all stationary engines are custom built and that a standard for stationary engine belt speeds serves very little purpose.

Bumpers

THE Society is preparing to survey current practice in the mounting-height of bumpers from the viewpoint of revising the present SAE bumper standard (p. 88, 1937 SAE HANDBOOK). Damage to radiator grilles caused by light trucks without bumpers backing into them and comments from the medical profession to the effect that leg fractures caused by bumpers at their present height are more serious coming below the knee than they would be above the knee, are reasons for this study.

Spark Plugs

THE presentation of the report "An Investigation of Mica Spark Plugs," by M. F. Peters, H. K. King and J. P. Boston, accompanied by an allied report, "Electrical Character of the Spark Discharge of Automotive Ignition Systems," at the Summer Meeting, closes the spark plug investigation conducted at the National Bureau of Standards under guidance of the SAE Ignition Research Committee, so far as the committee and the Society are concerned.

Lamps

AN SAE recommended practice for laboratory tests of physical and optical characteristics of adverse-weather lamps for motor-vehicles has just been adopted by the Society. Work was concentrated on the project to meet an urgent need expressed for it by some of the states, notably Pennsylvania.

The specifications are based on the assumption that assurance of reasonable safety when driving in fog, rain or snow requires a major reduction in speed, and the desirability of having a reasonable distribution of light.

The recommended practice includes a definition of adverse-weather lamps, and data as to color, scope of the specifications, laboratory facilities and specifications for laboratory and photometric tests. This new recommended practice will be available shortly and will be included in the 1938 edition of the SAE HANDBOOK.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between May 15, 1937, and June 15, 1937.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

BECKWITH, BRYSON B. (M) metallurgist, Chrysler Motors, 341 Massachusetts Ave., Detroit, Mich.; (mail) 59 Oakdale Blvd., Pleasant Ridge, Royal Oak, Mich.

BOLLES, JAMES C. (M) sales manager, National Automotive Fibres, Inc., 19925 Hoover Ave., Detroit, Mich.

BOLON, GUS GEORGE (A) shop foreman, Cascade Investment Co., Portland, Ore.; (mail) Adrian Hotel, 422 South East Morrison St.

BORGER, JOHN GODFREY (J) junior engineer, maintenance department, Pan American Airways Co., Port Washington Airport, Port Washington, L. I., N. Y.

BRINEN, HOWARD F. (J) laboratory engineer, Young Radiator Co., 709 Marquette St., Racine, Wis.

CASEY, FRANK E. (A) assistant manager of sales, National Pneumatic Co., Inc., 420 Lexington Ave., New York City.

CONWAY, WILLIAM E. (A) assistant director, sales, truck division, Studebaker Corp., South Bend, Ind.; (mail) 321 East 43rd St., New York City.

COUSINS, ROY F. (A) garage superintendent, Davidson Baker Co., 700 North East 22nd Ave., Portland, Ore.

CUMMINGS, CAPT. EMERSON LEROY (S M) U. S. Army, Ordnance Dept., Washington, D. C.

DAVIS, BERNARD (A) 6 Franklin Gardens, Roxbury, Mass.

DEPARTMENT OF DEFENCE, Civil Aviation, Government of the Commonwealth of Australia (Depart'l) Melbourne, Australia. Rep: JOHNSTON, CAPT. E. C.

DERVIEU, MICHEL (A) director, fabrication, Etablissements Laffly, 94 Ave. des Gresillons, Asnieres, Seine, France; (mail) 63 rue Dulong, Paris, 17eme, France.

DODDS, VINCENT G. (A) salesman, Aluminum Co. of America, 1031 South Broadway, Los Angeles, Calif.

DUNNING, CHARLES L. (A) district service manager, White Motor Co., 458 Melwood St., Pittsburgh, Pa.

FALLON, FRANCIS X. (J) Diesel electric apprentice, New York, New Haven & Hartford Railroad Co., Dover St. Engine House, Boston, Mass.; (mail) 180 Kittredge St., Roslindale.

FRAZEUR, LESLIE (M) superintendent, service and maintenance, Eastern Air Lines, Division of North American Aviation, Inc., Post Office Box 3581, Miami, Florida.

FRIEND, P. E. (M) chief engineer, Wilkening Mfg. Co., 2000 South 71st St., Philadelphia, Pa.

HAMILTON, WILLIAM F. (M) Richfield Oil Co. of California, 555 South Flower St., Los Angeles, Calif.

HARRIS, WILLIAM H., JR. (J) engineer, Micromatic Hone Corp., 7401 Dubois St., Detroit, Mich.

HEYNES, WILLIAM MUNGER (F M) chief engineer, S. S. Cars, Ltd., Holbrook Lane, Coventry, Warwickshire, England; (mail) 167 Beechwood Ave.

HIRTLE, EUGENE G. (M) truck equipment engineer, Isaacson Iron Works, 2917 East Marginal Way, Seattle, Wash.

HOLDER, ALFRED ROGER (A) mechanic, White Motor Co., 605 King St., East, Toronto, Ontario, Canada.

HOLLINGSWORTH, R. BERNETT (A) branch manager, Autocar Trucks, 2804 West Broad St., Richmond, Va.

HULSE, STEWART H. (M) fuel technologist, Standard Oil Development Co., Post Office Box 243, Elizabeth, N. J.

JERROLD, GILBERT (F M) engineer, French Government, Scientifiques, Section des Moteurs, 4 rue de la Porte d'Issy, Paris XV, France.

JOHNSON, THOMAS EDMUND (A) senior inspector of aircraft, Commonwealth of Australia, Civil Aviation Board, Government Aerodrome, Mascot, New South Wales, Australia.

KESSLER, J. R. (J) Roberts Motor Co., Portland, Ore.; (mail) 123 North East Pacific St.

KIDD, ROBERT STORMONT (A) draftsman, Ranger Engrg. Corp., Farmingdale, L. I., N. Y.; (mail) 312 Main St.

KIMBER, CECIL (F M) managing director, M G Car Co., Ltd., Abingdon, Berks, England; (mail) Boundary House.

LABORY, R. F. (A) automotive department clerk, Union Oil Co. of California, 617 West Seventh St., Los Angeles, Calif.

LARSON, KARL OLIVER (M) technical assistant, Northwest Airlines, Inc., St. Paul, Minn.

LOVELL, HALTON A. (A) manager, Toronto and Winnipeg Branches, Snap-On Tools of Canada, Ltd., 504½ Church St., Toronto, Ontario, Canada; (mail) 80 Hoyle Ave.

MCGREGOR, THOMAS ATKINSON (M) chief engineer, American Forging & Socket Co., Branch St. & Air Line R.R., Pontiac, Mich.; (mail) 43 Illinois Ave.

MCWHORTER, JOHN FRANCIS (M) production development engineer, Ohio Rubber Co., Ben Hur Ave., Willoughby, Ohio.

MEZEY, JAMES N. (J) automotive service engineer, Tide Water Associated Oil Co., 17 Battery Place, New York City; (mail) 406 East 91st St.

MOUTIER, FIRMIN L. (A) general service and parts manager, Cadillac Motor Car Division of General Motors Sales Corp., 521 West 57th St., New York City; (mail) Room 950 Y. M. C. A., 5 West 63rd St.

NUNNENKAMP, WILLIAM (A) service manager, Fields Motor Car Co., Portland, Ore.; (mail) 4304 S.E. Salmon St.

PRAY, HARLEY L. (A) president, Tulsa Winch Mfg. Corp., 823 East First St., Tulsa, Okla.

RAYMOND, ARTHUR E. (M) vice-president, charge of engineering, Douglas Aircraft Co., Inc., 3000 Ocean Park Blvd., Santa Monica, Calif.

(Continued on next page)

REUTHER, MARTIN ERNST (J) draftsman, Fisher Body Engineering, Detroit, Mich.; (mail) 14595 Greenview Ave.

ROBINSON, SAMUEL T. (M) field engineer, Wright Aeronautical Corp., Paterson, N. J.; (mail) Kurgarten-Hotel, Friedrichshafen, am Bodensee, Germany.

SAMUELS, WILLIAM (M) project engineer, Chevrolet Motor Co., General Motors Bldg., Detroit, Mich.

SCHULTZ, HOWARD W. (M) assistant chief engineer, Ohio Rubber Co., Ben Hur Ave., Willoughby, Ohio; (mail) 1343 Edanola Ave., Lakewood, Ohio.

SCHUMACHER, RALPH O. (M) motor vehicle supervisor, Postal Telegraph-Cable Co., 67 Broad St., New York City.

SCOTT, LELAND L. (M) designer and president, Scott Aircraft Motors, 2537 South West Boulevard, Kansas City, Mo.

SHMIDT, GREGORY E. (A) director, machine tool department, Amtorg Trading Corp., 261 Fifth Ave., New York City.

SIPOS, JOSEPH N. (J) body draftsman, Fisher Body Corp., Body Engineering Dept., Detroit, Mich.

SMITH, EDWIN K. (M) metallurgist, Electro Metallurgical Co., 1210 Ford Bldg., Detroit, Mich.

SMITH, FRANK WESLEY (A) manager, Lube oil sales and power prover service, Cities Service Oil Co., 260 Tremont St., Boston, Mass.

STRATTON, LLOYD O. (A) 404 Spalding Bldg., Portland, Ore.

STRICK, ANTHONY DAVID C. (J) assistant engineer, Birmingham & Midland Omnibus Co., Ltd., Bearwood, Birmingham, England; (mail) 24 Willow Ave., Edgbaston, Birmingham, England.

SZYMANOWITZ, RAYMOND (M) technical director, Acheson Colloids Corp., 444 Madison Ave., New York City.

TOWNSEND, JAMES K. (J) machine designer, National Broach & Machine Co., Shoemaker & St. Jean, Detroit, Mich.; (mail) General Delivery, Birmingham, England.

VAN DRONGELEN, VICTOR JOHN (A) garage man, Seattle Garage, 1426 Broadway, Seattle, Wash.; (mail) 3637-14th St., West.

WEASLER, ANTHONY V. (M) manager, Pick Mfg. Co., Box 25, West Bend, Wis.

WERDER, JOHN FREDERICK (A) vice-president, charge of engineering, Zip Abrasive Co., Center & Washington Streets, Cleveland, Ohio; (mail) 2126 Lincoln Ave., Lakewood, Ohio.

WHITNEY, ERNEST G. (S M) associate mechanical engineer, head, engine research section, National Advisory Committee for Aeronautics, Langley Field, Hampton, Va.; (mail) 104 Linden Ave.

WOLCOTT, C. FREDERICK (M) charge of radio engineering, Noblitt-Sparks Industries, Inc., Columbus, Ind.; (mail) 1121 Sycamore St.

Applications Received

The applications for membership received between May 15, 1937, and June 15, 1937, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

AGERELL, WILLIAM C., chief engineer, Pines Winterfront Co., Chicago, Ill.

AMBROSE, HENRY A., research chemist, Gulf Research & Development Co., Pittsburgh, Pa.

ARCAND, EUGENE JOSEPH, sales manager, Arcand Spring Co., Boston, Mass.

BERTHOLET, B. E., sales engineer, Allen Electric & Equipment Co., Kalamazoo, Mich.

BJORNSTAD, AAGE, manager sales department, Norsk Braendselolje A/S, Oslo, Norway.

BLACKWOOD, ROBERT RUTHERFORD, rubber technologist, Dunlop Perdriau Rubber Co. Ltd., Melbourne CI, Victoria, Australia.

BLEGVAD, VIGGO MARSTRAND, engineer, General Motors Truck & Coach Corp., Pontiac, Mich.

BROWN, LESTER, instructor, Board of Education, Canton, O.

CANDY, JAMES BENTLEY, lubrication engineer, D. A. Lubricant Co., Indianapolis, Ind.

DAVEY, PAUL H., president and treasurer, Davey Compressor Co. Inc., Kent, O.

EBINGER, ADAM, superintendent of garages, St. Louis Public Service Co., St. Louis, Mo.

EDDY, W. P., Jr., metallurgical and service engineer, Yellow Truck & Coach Mfg. Co., Pontiac, Mich.

FAGEOL, ROBLEY D., president, Leibing Automotive Devices Inc., Detroit, Mich.

FENSTEMAKER, JAMES FRANKLIN, industrial sales engineer, Socony-Vacuum Oil Co. Inc., Newark, N. J.

FICKEN, GEORGE V., engineer, Socony-Vacuum Oil Co. Inc., New York City.

FRASER, DONALD MCLEOD, partner, Peerless Engineering Co., Toronto, Ont., Canada.

HERZFELD, EUGENE, consulting engineer, New York City.

HILL, HOWARD, Mendenhall Motor Co., St. Louis, Mo.

HILL, PETER LIONEL, workshop officer, Royal Indian Army Service Corps, Quetto, Baluchistan, India.

HOFFMAN, CLIFFORD IRWIN, district manager, John Bean Mfg. Co., Chicago, Ill.

HOOD, G. G., vice-president, Ontario Steel Products Co. Ltd., Gananoque, Ont., Canada.

IRISH, GEORGE H., supervisor transportation, Tennessee Valley Authority, Knoxville, Tenn.

KLAS, HAROLD W., designer, Packard Motor Car Co., Detroit, Mich.

KOMOROWSKI, GEORGE, president, Lilpop, Raux, Loewenstein, Warsaw, Poland.

LANGLEY, P. L., Walcha, New South Wales, Australia.

LARSSON, ERIK LAMBERT, general manager, L. A. Larssons Gjuteri & Mek. Verkstad, Kristienhamn, Sweden.

LAWRASON, ALAN B., salesman, Railway & Power Engineering Corp. Ltd., Toronto, Ont., Canada.

MARANOV, SIDNEY, manager, Balmacaan Racing Team Inc., Westbury, L. I., N. Y.

MARTIN-HURST, WILLIAM F. F., managing director, The British Thermostat Co. Ltd., Sunbury-on-Thames, Middlesex, England.

MARTIN, ROBERT C., engineering dept., Fairbanks-Morse, Three Rivers, Mich.

METROPOLITAN BODY CO., Bridgeport, Conn.

MILLER, DAVID C., junior sales engineer, Amplex Division, Chrysler Corp., Detroit, Mich.

MILLER, RICHARD B., 141 East 19th St., Brooklyn, N. Y.

MINKE, RALPH A., sales engineer, Thompson Products Inc., Cleveland, O.

MOTT, BENJAMIN CORNELL, director field observation section, General Motors Corp., Detroit.

OLSEN, RAYMOND CHARLES, supervisor salvage, inspection and specifications, Chevrolet Motor Co., Oakland, Calif.

PETTERSON, HELMER, service manager, Gustaf Byrenius A.B., Stockholm, Sweden.

REYNA, CARL ALAN, superintendent of maintenance, Bell Brook Dairies, San Francisco, Calif.

RUPP, ARTHUR W., division supervisor of buildings, supplies and motor equipment, Illinois Bell Telephone Co., Chicago, Ill.

SINGER, GEORGE K., engineer, Socony-Vacuum Oil Co. Inc., New York City.

STRAWN, HARVIE H., transportation engineer, International Harvester Export Co., Chicago, Ill.

STREK, OTTO, layout man, Fisher Body Corp., Detroit, Mich.

SUGIURA, SHIGEZO, chief engineer, Sumitomo Metal Industries Ltd., Osaka, Japan.

TAYLOR, J. WILLIAM, designing engineer, Walker's Trailer & Tire Service, Portland, Oregon.

WALLS, FRED J., metallurgist, International Nickel Co., New York City.

WEISE, CARL A., engineer, Atlas Imperial Diesel Engine Co., Mattoon, Ill.

WHITE, S. BALLARD, Jr., manager, E. H. White Co. and L. F. & D. Equipment Co., San Francisco, Calif.

WHITTAKER, HARRY MILES, chief engineer, Micromatic Hone Co., Detroit, Mich.

WIEGAND, FRANCIS JOSEPH, test engineer, Wright Aeronautical Corp., Paterson, N. J.

WRIGHT, JOSEPH PRESTON, plant superintendent, Cities Service Oil Co., Milwaukee, Wis.

SAE *Coming* EVENTS

Cleveland Section Regional Tractor Meeting
Sept. 15-17
Akron, Ohio

Fuels and Lubricants Regional Meeting
Sept. 30 & Oct. 1
Tulsa, Okla.

National Aircraft Production Meeting
Oct. 7-9
Ambassador Hotel
Los Angeles, Calif.

Annual Dinner
Oct. 28
Commodore Hotel
New York

National Production Meeting
Dec. 8-10
Flint, Mich.

News of the Society

Shaw, Oldfield, Duray On Pre-Race Program

• Indiana

Wilbur Shaw, who was later to drive his Shaw-Gilmore Special to a new track record in winning the Memorial Day race at the Indianapolis Speedway, shared the Indiana Section's pre-race meeting program with Lee Oldfield, vice-president and chief engineer, Bennett Manufacturing Co., and Leon Duray, both of whom had cars entered. More than 285 members and guests attended this May 20 meeting which was devoted, for most part, to the discussion of the rules for the race.

Lee Oldfield, in opening the meeting, brought out the fact that the race rules are fixed in an open meeting in Detroit. This year, for the first time, he said, car owners and drivers were the only ones who had a vote on the final adoption of the rules; technical and AAA men were permitted to discuss and voice opinion but had no voting privilege. Although the rule that only commercial grades of gasoline would be permitted was strongly opposed by the technical men, the drivers and owners wanted it and voted for it, he said. It was also voted, Mr. Oldfield reported, that car specifications which had been in force should continue and that there should be no change in weight rules.

Mr. Oldfield's statement that after lowering compression ratios the racing crowd was shocked by the fact that better time could be made using a lower grade fuel brought comments from Messrs. Duray and Shaw. They contended that track improvements and the fact that there is no limit on the quantity of fuel consumed are the factors making for better time.

"No Car Rides Worth a Hoot," Declares Olley

• Canadian

"We have made a start at discovering something about riding qualities but so far no car has been produced that rides worth a hoot," was the opinion stated by Maurice Olley, suspension engineer, Cadillac, in his talk before the annual Oshawa meeting of the Canadian Section, May 14. Section Chairman Max Evans presided and the speaker was introduced by Past-Chairman George Garner, chief engineer, General Motors of Canada.

"Any combination of mass and spring has a natural resonant frequency which may be excited by the road," Mr. Olley pointed out, adding that "while independent wheels have theoretically one mode of vibration, axles have three or four. The body has a number of modes of oscillation communicated to it through the springs and axles. The ride of the car is, therefore, no true picture of the road. It is made up of the typical natural frequencies of its parts excited in different ways by different speeds and road surfaces."

Discussing axle versus independent suspensions, Mr. Olley first touched upon the definite difference in motion of the unsprung masses. Diagrammatically he showed the one characteristic form of hop of independent wheels. Axles, he stated, have at least four modes: parallel, one-wheel tramp, full tramp and self-induced cycle using side thrust of tires in front and camber thrust at rear. In other words, he added, "one difference between axle and independent suspension is that an axle couples two wheels together setting up complex motions which are entirely absent in independents."

In regards to spring masses he discussed the swing axle versus the ordinary axle. About half of the front ends currently produced, he said, have coil springs and it is his opinion that it will be only a matter of time until

(Continued on next page)

Field Editors

Baltimore – Espy W. H. Williams
Buffalo – O. A. Hansen
Canadian – Warren B. Hastings
Chicago – Austin W. Stromberg
Cleveland – William G. Piwonka
Dayton – Mearick Funkhouser
Detroit – William F. Sherman
Indiana – Harlow Hyde
Kansas City – No Appointment
Metropolitan – Leslie Peat
Milwaukee – Max Hofmann
New England – J. T. Sullivan
No. California – C. W. Spring
Northwest – R. J. Hutchinson
Oregon – Philip Cogswell
Philadelphia – Henry Jennings
Pittsburgh – Murray Fahnestock
St. Louis – C. T. Schaefer
So. California – W. G. Chamberlin
So. New England – John G. Lee
Syracuse – No Appointment
Washington – R. E. Plimpton

SAE Ordnance Advisory Committee Meets Army Group

The SAE Ordnance Advisory Committee met with a group of officers of the U. S. Army Ordnance Department at Peoria, June 7. The following day they were guests of the Rock Island Arsenal at Rock Island, Ill.

This picture, taken at the Peoria plant of Caterpillar Tractor Co. which was host to the group on the first day, shows: seated, from the left, *A. W. Scarratt, Col. G. A. Green, Col. H. W. Alden (chairman),* Col. G. F. Jenks, Col. C. M. Wesson, *Col. W. G. Wall* and *A. J. Scaife.* Second row, *H. H. Howard, J. E. Hale, Col. A. W. S. Herrington, G. A. Round, John A. C. Warner,* Col. R. W. Case, *E. F. Norelius* and *H. A. Knox.* Back row, Maj. J. K. Christmas, *Col. Paul Weeks,* Lieut. Col. A. B. Johnson, Capt. J. E. B. McInerney, *W. F. Beasley, H. T. McDonald,* Capt. E. L. Cummings and *Lieut. Col. B. O. Lewis.* Names of SAE members are in italics.

rear-end suspension is also of the coil spring type.

Mr. Olley cited the advantages of the coil spring to be that they are frictionless and weatherproof, have approximately two-and-one-half times the working efficiency per pound, are longer lived, and are almost free from road breakages; adding "the coil is much better where wheels are held by a separate structure." He stated that the only practical spring-rate test that is of practical value is the test of the vehicle under driving conditions.

Before concluding Mr. Olley paid tribute to the tire companies for their research work.

A golf tournament preceded the dinner-meeting. General Motors of Canada was host.

Aircraft Men Attend NACA Research Conference

Air-minded SAE members were prominent among the guests of the National Advisory Committee for Aeronautics at the Twelfth Annual Aircraft Engineering Research Conference, held under its auspices, May 18 and 20, at Langley Memorial Aeronautical Laboratory, Langley Field, Va.

The purpose of the Committee's annual confidential conference is to afford to the representatives of the American aircraft industry, other Government organizations, educational institutions, engineering societies, and others concerned with aeronautics, an opportunity to receive first-hand reports of the progress in aeronautical research at the Committee's laboratory and to witness demonstrations of the special equipment used; also to enable the Committee to obtain the comments and suggestions of those attending the conference as to research problems that are deemed of particular importance at the present time.

Among SAE members taking part in the program were: Henry J. E. Reid, engineer-in-charge, Langley Memorial Aeronautical Laboratory; John W. Crowley, Jr., chief, flight research section, N.A.C.A.; Carlton Kemper, chief, aircraft engine division, N.A.C.A.; E. P. Warner; Dr. George W. Lewis, director, aeronautical research, N.A.C.A.; Dr. H. C. Dickinson, chief, heat & power division, National Bureau of Standards.

Maintenance Methods Declared Backward

• Pittsburgh

"Carriages without horses shall go
And accidents fill the world with woe;
Iron in water shall float
As easy as a wooden boat.
Under water men shall walk
Shall ride and sleep and talk;
In the air men shall be seen,
In white, in black and in green.
Through the hills men shall ride
And no horse or ass be by their side.
Around the world thoughts shall fly
In a twinkling of an eye."

Quoting this prediction of the march of transportation made by Mother Shipston over 400 years ago, O. M. Brede, director of service, General Motors Truck & Coach Div., Yellow Truck & Coach Mfg. Co., introduced his paper, "Has Maintenance Kept Pace with Transportation?" to 210 members and guests attending the May 25 meeting of the Pittsburgh Section. Mother Shipston was then called a witch, he said, but on her tomb at Clifton, England, the epitaph reads, "Here lies one who never ly'd. Whose skill so often has been try'd. Her prophecies shall still survive and keep her name alive."

Mr. Brede then sketched the history of transportation up to the present time. "Looking back over this rapid evolution," he said, "we observe that maintenance methods have not kept pace . . . the large majority of motor-vehicles are repaired only when they fail to operate or when the need for repairs is so obvious that the owner's conscience demands them. No systematic plan of maintenance is observed universally."

Emphasizing the importance of real mechanics—men of skill and knowledge; the need of proper working conditions and adequate tools, Mr. Brede spoke particularly of preventive maintenance.

The first phase of preventive maintenance, he declared, is to develop "a scientific method of anticipating and performing required maintenance operations." This, he said, can be based upon results of researches which have established the mileage at which certain truck parts should be inspected, adjusted or replaced. He then explained a preventive maintenance system developed by the General Motors Truck Co., which prescribes the mechanical operations to be performed regularly at various mileages throughout the life of the vehicle.

"A systematic method of accumulating and interpreting operating and maintenance data," is the second phase of preventive maintenance, Mr. Brede explained. He then described development of a chart, as recommended by General Motors Truck Co., which simplifies this phase of maintenance. Through this record, he stated, "the complete shop activity is readily interpreted by the practiced eye. Frequency of service . . . inefficient repairs . . . road failures, come to the attention of those in charge. Chronic ailments stand out vividly and corrections based upon fact can be applied to vehicle or personnel." He also described a second chart which pictures the fleet history record, reflecting the safe economic mileage life of all important parts of the vehicle.

Hypoid Paper Read At SAE Club Meeting

• Denver

When the SAE Club of Denver met May 14, the paper, "Hypoid Rear-Axle Design and Lubrication," which W. R. Griswold, Packard chief research engineer, presented before the Annual Meeting in Detroit last January, was read by Club Secretary Joseph P. Ruth. With him on the program was H. E. Seanor, vice-president of the White Co.

More than 100 members and guests were assembled at the establishment of Dean M. Gillespie, who was host of the meeting.

SAE Men Prominent On Safety Foundation

Members of the SAE are taking an active part in the work of the Automotive Safety Foundation, established last month by a group of nearly one hundred top ranking executives of the car, bus, truck, tire, accessory and finance companies.

Paul G. Hoffman, president of Studebaker, was elected president. Other officers of the Foundation who are SAE members are: vice-president, C. C. Carlton, secretary of Motor Wheel Corp., and president of the Automotive Parts & Equipment Association; treasurer, Byron C. Foy, president, DeSoto Motor Corp.; assistant treasurer, Alfred Reeves, vice-president and general manager, Automobile Manufacturers Association.

The objectives of the Foundation are: "To foster the general welfare and to promote the mutual interests of the public and the automotive industries by encouraging the safe and efficient use of streets and highways; by stimulating research into the cause of street and highway accidents; and by disseminating information on the safe use of motor-vehicles, on effective methods of preventing accidents, on ways and means of relieving congestion and facilitating traffic with safety, and on other matters affecting the motor-vehicle and its use."

SAE members serving as trustees include: Walter P. Chrysler, chairman, Chrysler Corp.; B. E. Hutchinson, vice-president, Chrysler Corp.; K. T. Keller, president, Chrysler Corp.; William S. Knudsen, president, General Motors Corp.; Alvan Macauley, president, Packard Motor Car Co.; Alfred P. Sloan, Jr., chairman, General Motors Corp.; Vincent Bendix, president, Bendix Aviation Corp.; C. S. Davis, president, Borg-Warner Corp.; D. H. Kelly, vice-president, Electric Auto-Lite Co.; D. W. Rodger, vice-president, Federal-Mogul Corp.; J. Y. Scott, executive vice-president, Van Norman Machine Tool Co.; Lothair Teetor, vice-president, Perfect Circle Co.; Hugh H. C. Weed,

Aircraft Speed Increase of 1% per 1000 ft. Altitude Seen Indicated by Present Design

• No. California

ABOUT one per cent increase in flying speed for every additional 1000 ft. of altitude is indicated by present commercial transport design, members and guests attending Northern California Section's final meeting of the season, June 8, were told by Allan Bonnalie, director of technical instruction, Boeing School of Aeronautics.

With the realization of supercharged cabins, Mr. Bonnalie continued, flight at altitudes in the neighborhood of 30,000 ft. will permit the utilization of this increased speed. Coupled with greater flying range, he added, these altitudes will also obviate the necessity of following the irregular courses marked by radio beacons or detouring around mountains and bad weather areas.

He then told of aircraft as large as 84,000 lb. in weight with a cruising radius of approximately 5000 miles, that are in stages of final design or under construction. Land planes that are soon to be put into service will have a cruising range of some 2200 miles, he said, noting that the present range is 1200 miles.

Seaplane speeds in the neighborhood of 450 m.p.h. have been developed due to intensive study and international competition, Mr. Bonnalie said, explaining that ships attaining such speeds are so specialized and highly powered that they are useless for anything but short dashes. Some, he added, have a gasoline capacity so small as to permit only 45 min. of flight.

Regarding land-plane speeds he said that while they are progressing upward they have not been so spectacular as seaplane records. He noted, however, that the present land-plane speed record of some 300 m.p.h. was accomplished with a plane capable of flying non-stop from Los Angeles to New York.

Mr. Bonnalie's remarks, which were well illustrated by slides, brought forth considerable discussion during which he expressed his opinion that it will be a long time before the so-called "fool-proof" airplane is developed to the point that privately owned planes would enter the picture in large numbers.

After the dinner meeting, at which A. G. Marshall, chairman for the past year, presided, about 100 of those attending visited the Oakland Airport. Conducted by Willis Camp they inspected the Boeing School of Aeronautics and United Air Lines' planes.

vice-president, Carter Carburetor Corp.; Walter O. Briggs, chairman, Briggs Manufacturing Co.; Harvey S. Firestone, chairman, Firestone Tire & Rubber Co.; P. W. Litchfield, president, Goodyear Tire & Rubber Co.

Student Paper Contest Winners Announced

• Oregon State

Alexander Bedford, Jr., a senior in mechanical engineering at the Oregon State College, was awarded first prize in the 1937 student paper contest sponsored by the Oregon Section. The presentation was made at a joint banquet of the student branches of the SAE, the American Society for Metals and the American Society of Mechanical Engineers, climaxing the Engineer's Day celebration at the college, May 15.

Mr. Bedford, who last year placed fifth in the contest, had as his subject for the prize-winning paper, "A New Governing Method for Improving the Flexibility and Economy of Two-Cycle Engines." The second prize was won by Samuel Tabor for his paper, "Performance Tests for a Gwinn Special Aero Engine," and John P. McDermott received the third prize. Honorable mention went to Edwin Cooley.

Members of the Oregon Section heard each contestant read a brief of his paper at the May 14 Section meeting, and his presentation was taken into consideration by the judges in making the selection.

SAE Student Branch at Oregon State College

These members of the SAE Student Branch at Oregon State College were photographed in the mechanical engineering laboratory of the college. The Branch had 27 members at the end of the 1936-1937 school year.

Reports 40% Decrease in Aircraft Engine Weight

• So. California

Aircraft engines now weigh approximately 40 per cent less per horsepower than they did six years ago, declared Edwin O. Cooper, general service manager, Pacific Airmotive Corp., before 125 members and guests attending Southern California Section's annual Aircraft Engine Meeting, April 30. Introduced by Gunnar Edenquist, chairman of the Section's Aircraft Engine Committee, Mr. Cooper took as his subject "Aircraft Engine Maintenance." Ivar L. Shogran, powerplant engineer, Douglas Aircraft Co., the other principal speaker, discussed "Aircraft Engine Installations."

Continuing Mr. Cooper explained that over the six-year period engine weights have decreased from 1.75 lb. per hp. to about 1 lb. per hp. He also noted that the period between overhauls has been increased 50 per cent; present practice being to overhaul an engine every 550 to 600 hr. The cost of overhauls, he added, has been reduced from approximately $3.50 per operating hour to the present average of $1.50.

"The main unsolved problems on which the manufacturers are devoting their efforts," Mr. Cooper stated, "are icing of the carburetor, abrasives entering the engine through the air scoop, accumulative drainage of oil in the engine following periods of idleness, sticking piston rings, inadequate filtration of new oil before it enters the engine, oil sludge formation and spark plugs.

"Rapid spark-plug electrode burning and break down of mica insulation make it necessary to give more frequent attention to spark plugs than to any other part of the engine, as it is necessary, in airline operation, to service them every 65 operating hours as compared to 125 hr. for the next most frequent service required."

Through the elimination of oil sludge deposits, Mr. Cooper believes, engine overhaul periods could be extended another 200 hr.

In the discussion following Mr. Cooper's paper it was brought out that the life of spark plugs has been decreased due to the fact that airliners are being designed to operate on leaner mixtures. In one cited example the cost of replacement plugs was said to more than offset the savings in fuel made by a leaner carburetor mixture.

Section Chairman L. J. Grunder entered the discussion to remark that he had been informed that half of the sludge found in aviation engines comes from a material in the fuel otherwise essential and beneficial to the engine in adding to its power. The nature of the other half is unknown, he said.

Mr. Shogran opened his paper by declaring that the installation of an engine in an airplane, as now practiced, is still somewhat distant from an exact science.

A serious problem when designing an engine section for a series of transport planes, he stated, is the increase in temperature of the air entering the carburetor air scoop during take off and single-engine climb. This, he said, results in a drop of about one per cent in horsepower for each 10 deg. fahr. rise. He found, by a temperature survey, that the hot air was being spilled out over the front of the anti-drag ring during these maneuvers. Adequate baffling of the cowling eliminated this difficulty without affecting the cooling of the engines, he added.

To reduce vibration, Mr. Shogran continued, the logical thing to do is to allow the engine all the freedom possible in the mount by using special rubber bushings at the engine-mount ring in addition to those at the firewall attachment of the mount. This, he noted, permits the engine to approximate its own natural frequency and thus raises the resonant period well above the operating range.

He spoke of an airplane, now under construction, to be powered with four Pratt & Whitney twin-row 2180 engines. The arrangement is unlike past practice, he explained, in that the main engines furnish power only for propulsion and the power for all accessories such as vacuum pumps, de-icer pumps, hydraulic pumps, and alternators for the 800 cycle 115 volt current used throughout the ship, is supplied by two Prestone-cooled auxiliary engines located in the in-board nacelles.

Mr. Shogran also mentioned a new carburetor with automatic mixture control that gives promise of eliminating much of the difficulty arising from carburetor icing, and also spoke of a new system using Aninol, an aniline-alcohol mixture, now being developed that involves a valve attachment to the throttle and mixture controls that injects this fluid, carried in a separate tank, into the carburetor through jets above predetermined manifold pressures, to increase the octane rating of the normal gasoline.

Discussion brought out the following opinions:

"Oil temperatures should be maintained within ± 10 deg. fahr. of the temperature recommended by the individual engine manufacturer."

"Air-cooled radial engines have greater power than liquid-cooled engines of comparable weight. We have been able to develop radial engines to a higher degree of efficiency in this country than have European manufacturers due in part to our superior ability in casting cylinders."

"We are more or less required to use engines that are developed for military purposes. Most of the expenses involved in developing new engines is borne by the Army and Navy and for economic reasons manufacturers of transport planes must use engines already available."

"Twin-row radial engines will probably be more in demand in the future than single-row engines due to their greater horsepower with reduced projected area."

"Diesel engines for aviation use do not show any advantage over gasoline engines except in long-range non-stop service where the plane is in flight over approximately 12 hr."

Standard Established For Machine Tapers

An American Standard for Machine Tapers of the Self-Holding Taper Series recently has been established under the procedure of the American Standards Association. The SAE took an active part as co-sponsor of the project with the National Machine Tool Builders' Association and the American Society of Mechanical Engineers. The SAE representatives on the Sectional Committee under which this standard was developed are: C. W. Spicer, chairman; J. A. Anglada, secretary; Earle Buckingham, H. S. Currier and E. N. Sawyer.

This standard establishes an American standard practice for the slope of self-holding machine tapers, the detailed dimensions for this type of taper tool shank and the corresponding dimensions for the taper socket in the spindle of the machine. The series includes 19 sizes

having slopes selected from series established by Brown & Sharpe in 1860, Morse in 1862, William Sellers & Co. in 1862 and Jarno in 1889. This composite series constitutes an appreciable reduction from the number of sizes now in use. It will later be supplemented by a companion standard for "steep" tapers.

Copies of the standard, designated B5. 10-1937, may be obtained from the American Standards Association or SAE headquarters. The price is 50 cents per copy.

Colwell Has Low Gross In Golf Tournament

• Cleveland

With Past Section Chairman A. T. Colwell winning first prize for low gross and Elmer Seigling winning first prize for low net, the Cleveland Section celebrated its annual outing on June 11. Ninety members and guests met at Lake Forest Country Club at Hudson, Ohio, where golf, putting and driving contests, bridge and indoor sports were directed by Robert M. Riblet and his committee.

Refreshments and dinner were followed by the award of prizes to the talented, after which the meeting adjourned to the ballroom for some excellent entertainment.

Second and third prizes were given to J. P. Weber and W. Wolf, for low gross, with the corresponding low net prizes going to Fred Fix and R. V. Hessler. Other prize winners were H. E. Simi, Ernest Wooler, B. F. Jones, W. E. Shively, R. Ballard, J. Shea, and many others.

Members Take Part In Driving Contest

• Northwest

The Northwest Section operated a proving ground at Fort Lawton, Seattle, May 15. New cars were furnished by local dealers for use in demonstrations. In the afternoon members put the cars through their paces and took part in a driving contest which was won by W. W. Churchill, superintendent of equipment, Washington Motor Coach Co.

Dinner was served in one of the Fort's mess halls, after which the afternoon's activities were discussed.

Retiring Chairman George Bock gave a short address on the benefits of SAE membership.

Assembles World's Iron And Steel Knowledge

T. H. Wickenden, International Nickel Co., Inc., as official SAE representative on the Iron Alloys Committee of the Engineering Foundation, took part in preparing a synthesis of the world's entire knowledge of plain, unalloyed steels and cast irons, which has just been completed.

The Foundation's committee, working in cooperation with the steel, automotive and other industries, spent four years of editorial research in the scientific literatures of all nations in preparing this work which is embodied in 1200 pages of a two-volume monograph. The announcement of the work states that it includes "all the essential facts on these vital materials which have been laboriously ascertained by a thousand scientists over a period of 50 years."

Quotes SAE Handbook

The new edition of the American Standard Approval Requirements for Central Heating Gas Appliances, in its appendix, quotes several tables taken from the SAE Handbook showing acceptable dimensions for all approved fittings on semi-rigid tubing. Nuts and screws of the fitting must be made with SAE standard threads, fine series, class 2 fit.

Eckener to Receive Guggenheim Award

The Daniel Guggenheim Medal for 1937 will be awarded to Dr. Hugo Eckener, chairman of the board, German Zeppelin Transport Co., "for notable contributions to trans-oceanic air transport and to international cooperation in aeronautics." The presentation will be made at a dinner to be given in his honor in New York on Dec. 17, the 34th anniversary of the first flight of the Wright brothers. It will be remembered that Dr. Eckener was the principal speaker at the SAE Annual Meeting banquet in Detroit last January.

At a recent meeting of the Daniel Guggenheim Medal Fund, T. P. Wright, vice-president of engineering, Curtiss-Wright Corp., was elected president to succeed Maj. E. E. Aldrin, Standard Oil Development Co. Sherman M. Fairchild will serve as vice-president. Other SAE members serving on the Board for 1937 include Charles H. Chatfield, Rear-Admiral Emory S. Land, Glenn L. Martin, Temple N. Joyce, Dr. George W. Lewis and William B. Mayo. Dr. Lewis was Guggenheim Medalist in 1936.

Welding Foundation Contest

Attention of automotive and aircraft designers and engineers is called to the 38 awards, totaling $24,700, for papers on automotive and aircraft subjects in the $200,000 Series of Awards, sponsored by The James F. Lincoln Arc Welding Foundation. Twenty-four awards totaling $14,200, are offered for automotive papers. Fourteen awards totaling $10,500, are offered for papers on aircraft subjects. Papers on automotive or aircraft subjects may win the grand award of $13,700. A total of 178 awards of $100 each are provided for papers receiving honorable mention.

Further particulars regarding these awards can be had by writing to SAE Headquarters.

About Authors

(*Continued from page 11*)

started work with the company's fleet of motor-vehicles and also participated in outside plant engineering. Transferring to the American Telephone and Telegraph Co., operation and engineering department, plant engineering division, in 1921, Mr. Smith's work since that time has been concerned with automotive and construction-apparatus engineering for that company. A member of the SAE since 1924, Mr. Smith has been active on many of the Society's technical and administrative Committees. He is just completing his term as 1936-1937 chairman of the Met Section.

• Charles Fayette Taylor *was in charge of U.S. Navy aeronautical engine laboratory during the war. In 1919 he resigned from active service with the rank of lieutenant in the Naval Reserve Force, and was appointed engineer in charge of power-plant laboratory, engineering division, U.S. Air Service at McCook Field. From 1923 to 1926 he was with the Wright Aeronautical Corp. in charge of engine design and development. In the latter year he joined the faculty of the Massachusetts Institute of Technology as associate professor in aeronautical engineering. Promoted to professor in 1929, he was appointed professor of automotive engineering in 1933 to take charge of instruction and research in internal combustion engines for both the aeronautical and mechanical engineering courses. He has been engaged by many important companies as consulting engineer.*

• Ralph H. Upson *was awarded the Wright Brothers Medal in 1929; designed the world's first successful metalclad airship, the ZMC-2 (U.S. Navy), now completing its eighth year of active service; and is winner of several international and national balloon races. After receiving his M.E. and Ae.E. degrees from Stevens Institute of Technology, Mr. Upson's early work was in aerodynamics and glider construction. He was with the Goodyear Tire & Rubber Co. from 1910 to 1920. For a time he alternated between aeronautic and tire research and was later in charge of airship design and development. He resigned to concentrate his efforts on the all-metal type of construction. He was chief engineer of Aircraft Development Co. when he designed the ZMC-2. Now, as consulting engineer and individual experimenter, his work includes airplanes, autogyros, streamline trains, general structural problems and various instruments and "gadgets." A charter member of the American Society of Aeronautical Engineers, Mr. Upson became an SAE member when that group affiliated with the Society in 1916.*

• Fred J. Walls *is author of the 1930 British exchange paper of the American Foundrymen's Association. After leaving the University of Michigan, where he studied mechanical engineering, he worked for Packard during 1914, and for a short time during the following year was with the Consolidated Manufacturing Co. Later in 1915 he joined the Wilson Foundry & Machine Co., with which he was affiliated for a number of years, rising from chemist to chief metallurgist. While with this company, Mr. Walls returned to the U. of Michigan specializing in metallurgy. In 1933 he did consulting work for the Eaton-Erb Foundry Co. and the next year was made this company's chief metallurgist and foundry manager. He joined International Nickel in 1935.*

• Austin M. Wolf, *in addition to carrying on a general consulting practice, is the man upon whom New York State relies as automotive consultant and director of standards. His yearly review of passenger car design trends in the SAE Journal has become one of the important technical events to which the industry looks forward. He has written extensively on automotive subjects for various publications.*

• Weldon Worth *became air-minded at 15. Starting at that early age he passed progressively through the stages of grease monkey, engine and airplane mechanic and salesman under the tutorship of Ted Weaver (now a T.W.A. pilot) who then was operating a commercial flying field in Indianapolis, where Mr. Worth was living. By the time he was 17 he had learned to fly and was hopping passengers. In 1926 he passed the examination for an N.A.A. and F.A.I. pilot license and the next year did some aerial photography in California as a part of a geological survey. The summer of 1928 saw him barnstorming in Indiana. During the next four years he was absorbed in getting an engineering education at Purdue. Shortly after graduation in 1931 he went to Wright Field where he has since been working in the installation group of the powerplant branch. And Mr. Worth is a lawyer, gaining his LL.B. at the University of Dayton while working at Wright Field. He received his degree in 1935 and the same year was admitted to the Ohio Bar. He says that he doesn't intend to pursue the profession of law any further.*

What Foreign Technical Writers Are Saying

AIRCRAFT

Méthode des Filets de Fumée pour l'Etude de l'Ecoulement de l'Air autour des Obstacles

By Jacques Valensi. Published in *L'Aéronautique,* February, 1937, L'Aérotechnique section, p. 17. [A-1]

That the vapor method for the study of airflow about objects permits for the first time accurate observation of the cores of marginal eddies about propellers and wings is the claim of the author. The visualization of these eddy centers has led to the development of a new simple and easy method of measuring the circulation about these eddies. The vapor method is said to make possible not only qualitative but also quantitative studies of airflow about airplanes, with an accuracy and detail due to the type of vapor and lighting used.

The method consists of the emission from suitable distributers of air charged with ammonia hydrochloride into the aerodynamic field to be studied. These vapors are emitted either in the form of a continuous jet at the speed of the air current, or periodically, in small puffs of adjustable frequency. They are observed either stroboscopically by means of the Stroborama or continuously by means of a steady light. Because of their extreme smallness and lightness, the particles of vapor follow the movement of the air. When periodic emission of vapor and the Stroborama are used, the lights are flashed with the same frequency as the puffs. With a continuous jet, lines of emission are observed stroboscopically, and trajectories with the continuous light. The emission by puffs permits a determination, by points, of trajectories and velocities. Both methods permit photographic recording of the phenomena, no matter how great the speed of airflow.

The author commenced the study of the vapor method in 1933, at the Institute of the Mechanics of Fluids in Marseilles, and has applied it in the observation of airplane models in the laboratories at Issy, principally in the wind tunnel. He presents here accounts and photographs of numerous studies made of airflow about wings, propellers, the fuselage and tail surfaces of a low-wing monoplane, and of airplane stability.

Beiträge zur Flugtechnik

Edited by Richard Katzmayr. Published by Julius Springer, Vienna, Austria. 43 pp.; 19 illustrations. [A-1]

To commemorate the twenty-fifth anniversary of the founding of the aero-mechanics laboratory at the Vienna engineering college, this booklet has been published. It is made up of technical contributions from Austrian engineers and scientists who participated in the work of the laboratory at the height of its activity, during the World War, but who have since been for the most part scattered throughout various other countries.

R. v. Mises describes the design and experimental operation of a 600 hp. biplane developed under his supervision during the war; Dr. Magyar discusses a problem in airflow techniques, dealing with the conditions of adhesion in the flow of viscous liquids; A. Proll analyzes the method of determining the unsteady longitudinal movement of an airplane in a vertical plane; W. B. Klemperer concerns himself with present-day problems of motor-less flight; E. Milan covers questions which arise in connection with the design of open framework; L. Kirste presents a new method for designing box girders; J. Ratzersdorfer discusses the buckling strength of airplane struts; and a description of the laboratory is given.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

La Construction des Hangars d'Aviation en Allemagne

By Jacques Dumas. Published in *Le Génie Civil*, April 10, 1937, p. 334. [A-4]

In surveying hangar construction in Germany, the author emphasizes the preference given those designs which do not call for any intermediate pillars. For the accommodation of a like number of airplanes, such hangars may be smaller than hangars with intermediate pillars, and the increase in cost per unit of basic construction is offset by the smaller size and the savings in incidental expense because of this reduced size and less elaborate heating requirements. While economy indicates structures as large as possible, limits are set by the fire risk. In practice, such hangars run between 10,000 and 40,000 sq. ft., are rectangular in shape and generally have the door on the larger side of the rectangle, the length of this side being up to about 300 ft.

Details of construction used in steel and reinforced concrete are given.

ENGINES

Detonation and Stationary Gas Waves in Petrol Engines

By G. D. Boerlage, J. J. Broeze, H. Van Driel and L. A. Peletier. Published in *Engineering*, March 5, 1937, p. 254. [E-1]

Results reported in a recent paper in which a description was given of experiments in the laboratory at Delft on an engine fitted with windows in which flame movements could be studied somewhat on the lines of the research carried out at the General Motors Research Laboratories and by M. Duchene, gave rise to the questions which the present study attempts to answer.

In the earlier work detonation in the usual sense of the word often occurred and knock could be heard when the vibrations were not visible; and it was believed probable that a slight pinking noise coincided with the occurrence of the vibrations but was drowned in the general noise of the engine. These results raised the question whether the recording of such excessive local pressures might have been due to instrumental errors or whether a pinking engine might have behaved differently. From these results the desirability of observing pressures in several places on a pinking engine was made clear and this the authors have since done and report here. They give an account of the pressure investigations carried out on an L-head single-cylinder gasoline engine with a bore of 98 mm. and a piston stroke of 108 mm., under severe pinking conditions. The combustion chamber was provided with 9 apertures for spark plugs and for observation points in which pressure could be observed with a piezo-electric indicator. Experiments were made at 1,000 r.p.m., with "frequent heavy" detonation (aurally defined) caused by a combination of early ignition and low-octane fuel.

The following conclusions were drawn from these investigations: (a) Even with heavy pinking in this test engine there has been no indication of a local initial burst of excessive pressure rise at the point where detonation occurs. It does not, therefore, appear to be essential for detonation to have an excessive initial pressure burst. (b) In accordance with the work of previous investigators, detonation, causing a pressure disturbance, may result in stationary waves throughout the gas mass, the lowest frequency possible apparently predominating. (c) The amplitudes of these waves are a function of the severity of detonation, of the shape and size of the combustion chamber, and of the point of observation, but in this case not so much of the position of the original disturbance. (d) The distribution of the wave amplitudes may be such as to cause the highest total pressure to occur at a point different from that at which the end gas explodes, and it would appear that in considering detonation three typical regions will have to be considered: (1) the actual detonation corner or corners where the combustion of the end gas occurs, (2) the corner or corners where the vibrating pressure effect occurs, and (3) the corner or corners where the highest heat flow to the walls occurs.

It has now been found possible to show experimentally the connection between the pressure vibrations with the variations in luminosity. Further investigations will be made to show to what extent detonation contributes to the heat losses at the various observation points.

Injection ou Carburation? (Les Moteurs à Injection aux Salons de 1936)

By André Mandel. Published in *Journal de la Société des Ingénieurs de l'Automobile*, February, 1937, p. 67. [E-1]

Contrary to opinions frequently expressed, the author contends that competent engineers in France, Italy, Germany and England still insist that the injection engine may boast of many advantages in the field of aviation that the carbureter engine can never attain. He predicts that when the governing minds of the industry consider fully the disadvantages of the newer high-octane number fuels – among which he lists slow-burning, gum and deposit forming tendencies, and the requirement for special cylinder cooling – and the advantages of the detonating fuels, aliphatic, rich in hydrogen, which oxidize quickly and without deposit, the first knell will have sounded for the high-capacity carbureter engine. He foresees the general usage of the injected fuel, so defined, with gasoline relegated to slow, low-powered engines.

Before this can be achieved, the theoretical formulas which have governed Diesel engine development must be amended and amplified to

bring them in harmony with practice. He discusses particularly the dictum recently enunciated that the profile of the cam governing the piston of the fuel pump should assure it an acceleration proportional to that of the engine piston. He points out that it is the quantity of calories liberated by oxidation which should be in harmony with the movement of the engine piston. Hence the pulsating phenomena in the fuel system and the nature of the fuel must also be considered. At present only auto-ignition characteristics, as determined by cetane ratings, are considered; a further method of test should be developed to ascertain the combustion rate of the complete fuel.

That all manufacturers of motor-trucks offer Diesel engines; that several types or makes of engine are often included in one motor-truck line, indicating that the industry is still feeling its way; and that light trucks or even passenger-cars are now being Diesel powered, are some of the general developments remarked on. Features of special interest in the exhibits at the recent shows, the difficulties confronting French engineers, and proposed standards for methods of making and recording tests of Diesel engines are other topics dealt with.

PASSENGER CAR

Symposium on Research in Relation to the Motor Vehicle

Section 1, The Motor Vehicle, by C. G. Williams; Section 2, Fuels and Lubricants, by F. H. Garner; and Materials with Special Reference to Steel, by T. Swinden. Published in the *Journal of The Institution of Automobile Engineers*, March, 1937, p. 14. [L-1]

Mr. Williams, Director of Research for the Institution of Automobile Engineers, enumerates the types of laboratories in which automotive research is being carried on and points out that the main effect of research on the motor vehicle has been to lead to a fuller comprehension of the functioning of the mechanism, and to effect a rational and progressive development in its performance. The author includes under the broad term "performance" durability, economy, comfort, reliability and safety, and design problems. The last named the author illustrates with brief discussions on pistons, air cooling, exhaust valves, bearings, cylinder wear, consumption of lubricating oil, piston rings, electrical equipment, starting from cold, streamlining, comfort and noise.

In the paper which constitutes Section 2 of the symposium, Dr. Garner presents a broad summary of the progress in research as affecting fuels and lubricants. No attempt is made to consider fundamental research on combustion; the paper is confined to the results obtained by research on problems more directly connected with the practical operation of the engine. Under the heading: Fuels for Petrol Engines, Dr. Garner discusses ease of starting, warming-up and acceleration, vapor lock, dilution, anti-knock qualities and road ratings, and economy. He also covers briefly research on fuels for compression-ignition engines, and under the heading: Lubricants, discusses engine lubricating oils, sludge formation, bearing corrosion, oiliness agents, oil consumption and Extreme Pressure lubricants.

In an endeavor to indicate the trend of development of steels for the more important parts of the motor car, Mr. Swinden considers crankshafts, interpenetration by non-ferrous metals, valves, gears, camshafts and gudgeon-pins, connecting-rod, stub-axle, front-axle, propeller shafts, etc., machinability, springs, chassis and body.

Wie Sie Wurden

By Erich Gründger. Published in *Automobiltechnische Zeitschrift*, Feb. 15, p. 60; Feb. 25, 1937, p. 104. [L-1]

A brief historical survey of German passenger-car development is here presented. About 12 makes represented in the current market are discussed, the chief facts about their origin and subsequent history being given. Photographs of successive models illustrate the design development. The German automotive trade names that have disappeared since 1925, about 20 in number, are listed.

TRACTOR

Le XVI^e Salon de la Machine Agricole

By G. Coupan. Published in *Le Génie Civil*, April 17, 1937, p. 354. [M-1]

Because of the threats of labor strikes in France, farmers are turning willingly toward agricultural machinery. This was reflected in the selling activity at the 16th agricultural machinery show, which, in the case of some exhibitors, brought in more orders than can be filled under the prevailing industrial conditions. A need for widespread instruction in the use of agricultural machinery is indicated, according to the author.

While engines for smaller units are for the most part designed for the use of gasoline as fuel, those of the medium-sized and larger machines are of the heavy-oil type. Because of the high price of the latter type of fuel, gas producers have also made their appearance. A large proportion of tractors make use of caterpillar tracks, special steels are used in construction, and special purpose agricultural machinery is being developed.

A section of the exposition, provided for by the secretary of agriculture, had for its purpose the encouragement of the use of forest products and by-products, and featured gas producer units.

S. A. E. Papers in Digest

HERE are digests of papers presented at various meetings of the Society.
Some of these papers will be printed in full in the S.A.E. JOURNAL.
Mimeographed copies of *all papers received* will be available, until current supplies are exhausted, at a cost of 25 cents per copy to members; and at 50 cents per copy to non-members, plus 2% sales tax on those delivered in New York City. Orders for mimeographed copies must be accompanied by remittance and should be addressed to Sessions Secretary, Society of Automotive Engineers, 29 West 39th St., New York.

Regional Transportation and Maintenance Meeting

Baltimore, Md. – Apr. 15-16

Oil Filters in Public Utility Fleet Operation – ***James I. Clower, associate professor of machine design, Virginia Polytechnic Institute.***

THIS paper has to do mainly with the care of the oil while in service, which care is considered as important, or more so, than its selection. The author points out that at present there is no reliable scientific method or test for determining whether or not an oil is suitable for further use, and that oils do not wear out but simply become contaminated with various impurities.

Impurities that tend to produce changes in the characteristics of crankcase oils while in service are considered under headings of inherent impurities and extraneous or foreign impurities. A number of types of filters are discussed with elements of cotton waste, slag wool, (acid and alkaline), wool felt, Canton flannel, chemically treated paper, Fuller's earth, cellulose fiber, rock wool, brewer's filtermass, and felt discs. Ten desirable features of a good filter are enumerated.

Although admittedly a controversial issue, the author believes that filters are decidedly advantageous and economically justifiable especially from the standpoints of fewer oil changes, decreased oil consumption, and reduced bearing and cylinder wear.

A discussion of the time when a filter element should be changed concludes the paper.

Utility Trucks, Cabs, Bodies and Auxiliary Equipment – *T. C. Smith, American Telephone & Telegraph Co.* (Paper published in full, pages 273-283, Transactions Section, this issue.)

The Efficient and Economical Operation of the Automotive Equipment of a Public Utility – ***Warren R. Pollard, supervisor of automotive equipment, Georgia Power Co.***

IN this paper are set forth some of the basic principles underlying the efficient and dependable operation of a public-utility automotive fleet. It is the purpose to show the need of a central supervisory automotive force reporting directly to the management.

This force must select carefully the proper type of automotive equipment for the job; it must keep in close contact with all activities of the company to see that the proper facilities are provided and their use not abused; it must set up definite inspection and maintenance programs to give maximum economy and dependability; it must plan for the replacement of vehicles when they have outlived their usefulness; and it must work in conjunction with the safety department to see that the operation of the vehicles on the streets and highways is handled safely and in a manner which reflects credit on the company.

Executive Control of Public Utility Fleet Operations – ***F. B. Flahive, comptroller, Columbia Gas & Electric Corp.***

THREE methods of executive control for public utility fleet operations are outlined in this paper:

In the first, known as "direct control," the parent company sets up a transportation department headed by a man of executive ability and automotive experience who may or may not be an officer of the company. This department has complete charge of all transportation policies, passes on all purchase requisitions for transportation equipment, directs operations and maintenance and, in some cases, designs certain equipment.

"Control by analysis and suggestion" is the name of the second method in which an automotive engineer is employed who is qualified to analyze the operations of the fleet, but the responsibility for operating and maintaining the fleet remains with the operating executives.

"Committee control," the third method, has been applied successfully to decentralized organizations comprised of a number of groups. The board of directors of the parent company appoints a committee consisting of one qualified member from each operating group with an officer of the corporation as chairman; an automotive engineer acts as secretary of the committee.

Advantages and disadvantages of each method are considered.

A Study of the Safe Driver – ***J. W. Lord, Atlantic Refining Co.***

IN this paper safe drivers are studied to learn what to do, and drivers who have accidents are considered to learn what not to do.

The technique of the safe driver is discussed from the angles of mechanical handling and attitude toward maintenance, conduct on the highway, observance of traffic regulations, and courtesy on the highway. The importance of the proper use of the eyes in relation to directional signals is stressed.

Considerable space is devoted to a study of safe and unsafe driving from the standpoints of position on the highway, left turns, right turns, pedestrians and children, intersections, controlled speed, skidding, backing, and signaling.

Throttle Stops – ***O. A. Axelson, automotive engineer, Columbia Gas & Electric Corp.***

MORE power is being built into modern light passenger cars and trucks than is needed for ordinary fleet service. The use of this unnecessary power is an additional expense in the cost of operating the vehicles.

Fleet owners who desire economy above performance can secure this economy by limiting engine speed by means of throttle stops. The "Economy Models" now produced by leading manufacturers come equipped with throttle stops which limit the top speed and acceleration but do give better economy. Decreases in operating costs of as much as 30 per cent have been made by the use of throttle-stopped cars.

Results in Non-Changing Motor Oil – ***E. W. Jahn, superintendent of transportation, Consolidated Gas, Electric Light & Power Co. of Baltimore.***

A PRACTICE followed for five years of replenishing the oil in the crankcases of 20 Ford cars every 1000 miles, keeping it to the level recommended by the manufacturer, instead of draining it, is reported in this paper.

From chemical analysis of samples taken every 1000 miles it was found that dilution remained between 5 and 10 per cent, sediment remained more or less constant after building up to 1 per cent, there was less sludge than was observed during operation with regular changes, and but few cases of bearings being attacked because of acidity were detected.

Among the results reported is that the saving effected by not changing the oil more than offsets an increase in oil consumption, as indicated by greatly reduced total oil cost.

Pooling of Passenger Car Equipment – ***Jean Y. Ray, supervisor, automotive equipment, Virginia Electric and Power Co.***

DISADVANTAGES and inefficiencies of definitely assigning passenger cars to members of the organization are reviewed, and the policy of making allowances to employes to cover the use of their personal cars is discussed.

It is felt that pools can and should be set up to avoid the expensive and objectionable features of the preceding methods.

The main part of this paper describes a pooling set-up covering the operation of 272 vehicles serving 160,000 customers living in a territory of 10,000 sq. miles.

Some of the results of this pool operation are that the monthly average mileage per vehicle rose to 1385, and 25 passenger cars could be dropped from the fleet with an annual saving of $42,000 as compared with operation without the pool.

Fundamentals of Motor-Vehicle Performance

By Merrill C. Horine
Mack Manufacturing Corp.

WHEN we speak of performance today, with reference to commercial vehicles, we are obliged to speak in more specific and definite terms than ever before in automotive history. The time is past when there is anything remarkable about a motor truck which can run, and purchasers no longer adapt their operating schemes to the limitations of the vehicles which they happen to have purchased; but, to the contrary, it is the vehicle which must be adapted by the manufacturer to satisfy the performance requirements established by the purchaser.

The two principal characteristics of a commercial motor vehicle are its capacity and its performance ability, and it is the latter quality which actually makes a motor chassis necessary. A pair of saw-horses would provide all of the capacity required to support the body and its load. It is ability to perform that necessitates a chassis.

In a normal highway-transport problem, the operator is confronted by the necessity of carrying a stated payload in a body of definite weight over certain routes. From experience or by investigation, he knows the steepest grade on his routes or its equivalent in soft-road surface, and the maximum speed which is practicable and advantageous. In such circumstances, nobody has any difficulty whatever in selecting the proper tire size, and comparatively little trouble in choosing the proper size of chassis. Purchasers are reasonably adept at analyzing permissible tire overload, load distribution, and at giving at least some consideration to chassis robustness as reflected approximately by stripped chassis weight.

Nearly everybody realizes that neither too much chassis nor too much rubber, nor too little, will prove economical or reliable in the long run. There are also laws and administrative regulations which govern these matters in some degree.

But when it comes to judging performance, the same familiarity with the principles involved seems to be sadly lacking. The operator who would not for one moment consider trying to make an undersized tire serve, and who would shrink from over-tiring the truck beyond the manufacturer's authorized maximum, will quite blithely disregard engine power and torque, and endeavor by the use of semi-trailers, six-wheel attachments, or full trailers, to double the payload capacity of a given chassis, while still expecting fully satisfactory performance.

Another user who would frown on the suggestion that, by over-inflating undersized tires, he might beat the rubber barons, will be astonishingly credulous when assured that, without increase in the size of the engine, both the speed of a Zephyr and the pulling power of a Caterpillar tractor may be secured by the application of an auxiliary transmission or two-speed rear axle.

Trailers and Third Axles

It will therefore readily be apparent that it is impossible to increase the gross weight moved by a vehicle without at the same time reducing its performance ability, and in exact ratio. This reduction is quite regardless of whether the additional load is carried on the four wheels of the original vehicle, or whether it is shared by additional wheels, either in the form of an extra axle secured to the vehicle's own frame, or carried on a trailer which is dependent upon the vehicle for propulsion and/or partial support.

The statement, so often reiterated, that a vehicle can pull more than it can carry, has led to no end of confusion of thought. Strictly interpreted, this statement is true for, although the structural capacity of a chassis has a definite load limit, it develops sufficient tractive effort to move a greater load than it can carry when such load is supported by additional structure, but this additional structure need not be in the form of a trailer, but may just as well be added to the chassis itself, as in the case of an attachment six-wheeler.

In either case, however, although the truck may thus move more than it had capacity for in its original form, the assumption which is so often made, that this ability illustrates some mysterious principle to the effect that it is easier to pull a load than to push it and that it is more efficient to divide the func-

Horsepower-to-weight ratio is the basic fundamental of vehicle performance, contends Mr. Horine, giving simple mathematical formulas and reasons to show that no amount of manipulation with gears or axles can affect this primary relationship.

He concludes with a plea for the purchase and sale of commercial vehicles on a basis of required operating results rather than on the basis of features of construction for their own sake.

[This paper was presented at the Semi-Annual Meeting of the Society, White Sulphur Springs, West Va., May 6, 1937.]

tions of support and propulsion between two vehicles, is wholly fallacious.

This statement by no means implies that the semi-trailer itself is not a good and useful tool, having a wide and thoroughly legitimate field of application. My purpose in bringing these facts to light is to emphasize the fact that, for a given performance, a vehicle or combination of vehicles of given gross weight must have equal horsepower.

If, as so often happens, a 5-ton chassis may be used successfully to pull a 10-ton load by virtue of the use of a semi-trailer or six-wheel attachment, then obviously a 10-ton chassis equipped with an engine of the size used in the 5-ton truck would do equally well but, to secure from the 5-ton chassis and 10-ton trailer, performance equal to a normal 10-ton truck, it is necessary to equip the 5-ton tractor with an engine as large as used in the 10-ton chassis.

What is Performance?

For practical purposes, performance may be defined as the rate of maintenance of motion against the resistance to motion arising from: road surface, grades, snow, wind, and traffic.

As a general rule, the tractive resistance of the road surface is assumed at 30 lb. per ton, or 1.5 lb. per 100 lb. of gross vehicle weight. This value provides a rather generous amount of leeway, in view of the fact that the majority of our modern road and street surfaces have tractive resistance more nearly in the neighborhood of 20 lb. per ton.

Grades exert a uniform resistance to motion of 20 lb. per ton for each per cent of grade regardless of the road surface, this grade resistance being added to the road resistance.

Snow has the effect of greatly increasing tractive resistance and, in addition, reducing traction. In ordinary commercial application, it is quite impractical to attempt to provide in advance for this additional resistance, except in the way of providing sufficient extra low-gear grade ability so that, in the worst conditions, the wheels will lose traction before the engine stalls.

Wind resistance, as it is ordinarily termed, actually comprises two factors, namely, air resistance and wind resistance. Air resistance, or the resistance in still air, is dependent upon the projected frontal area and the K factor, regarding which we have heard so much in recent years. Wind resistance is simply the intensification or diminution of air resistance, according to the direction and velocity of the wind. On account of their great variability, the fact that air resistance is a very minor factor below 40 m.p.h., and the fact that on a round-trip the wind will be favorable as much of the distance as it is unfavorable, it is reasonable to ignore these factors, or to consider the air resistance as included in road resistance, and that the favorable or unfavorable incidence of wind resistance, in turn, cancels it out.

Of all the various impedances to performance, the greatest is undoubtedly traffic impedance, as represented by: first, the presence of other vehicles upon the highway moving in various directions, and so often at speeds different from that which it is sought to operate the commercial vehicle; second, the presence of stop signals and traffic officers along the route; and, third, the existence of arbitrary speed limits imposed by police authority.

Lastly, the weight of the vehicle and its load represents a resistance to motion which, in a mechanical sense, is the greatest of all.

Tractive Effort

To overcome all of these resistances and impedances to motion, a vehicle must possess the ability to exert tractive effort at the road wheels in varying amounts, at satisfactorily corresponding speeds.

All performance arises primarily from the single factor of engine horsepower, and the vehicle's performance potency basically must be always in proportion to the ratio of the engine's horsepower to the gross weight of the vehicle or combination of vehicles to be moved. In other words, we may rate the ability of a motor vehicle simply in terms of pounds of gross weight per horsepower.

This, however, is not the complete story, for it is necessary to apply the horsepower to the rear wheels at speeds and gear reductions appropriate to the varying resistances to be overcome and rates of acceleration required. This factor requires the inclusion of consideration of the torque characteristics of the engine, its governed speed, and the number and range of gear reductions available to the driver.

The problem would be simple indeed were a motor truck to operate under conditions as relatively fixed as we find in elevators working in vertical shafts, railroad trains running on practically level track of uniform surface quality, or marine vessels moving through a fluid of constant density. But it is because highway transport operation encounters resistances and impedances of such enormous variability that the problem of specifying, providing, rating, and checking of performance is so difficult.

In working with or discussing any measurable thing, some gage or measure of it must be found. How then shall motor-vehicle performance ability be measured?

Performance Ratings

A term which has considerable currency is the so-called ability factor and, although there appears to be no uniformity as to its use in general, it is understood to mean the tractive effort delivered at the rear tires, divided by the product of 20 times the gross vehicle weight, in tons. The typical formula for ability factor follows:

$$\frac{\text{Torque, in in-lb.} \times \text{Total Reduction} \times \text{Efficiency, in per cent}}{\text{Gross Vehicle Weight, in lb.} \times \text{Loaded Tire Radius, in in.}} = \text{Ability Factor}$$

To convert the result of this formula to actual grade ability, it is necessary to subtract the equivalent of the road resistance in terms of grade resistance. At 30 lb. per ton, this value, of course, amounts to $1\frac{1}{2}$ per cent grade or, as expressed decimally in the answer, 0.015.

One drawback to this form of rating is that it is based upon the peak torque of the engine, which peak occurs at an engine speed below that at which a competent driver will operate. It also provides no margin for loss of maximum torque output as a result of loss of motive power efficiency between overhauls, and is dependent upon the manufacturer's rating, which may or may not be overly optimistic.

Furthermore, this rating takes no account of speed and requires that it be worked out individually for each ratio and gear change. It is not subject to convenient or fair comparison because of variations in total gear ratio which affect the result.

The Myers tractive factor formula which, in essence, is virtually the same thing, suffers from the same limitation.

As a substitute, it has been proposed that motor-vehicle performance be expressed in terms of grade ability at 20 m.p.h., thus cancelling out the factor of variable ratios, but still based upon peak torque or manufacturer's rated torque. All three of the ratings so far mentioned fail in one common particular – they do not permit direct comparison between different vehicles, except when certain very definite allowances are made, and they do not readily permit direct interpretation in terms of the operator's problem.

Accordingly, on the principle that things equal to the same thing are equal to each other, but that things equal to differ-

ent things may or may not be equal to each other, the Society of Automotive Engineers, in 1932, appointed a Rating Committee to develop a standard method of rating motor trucks, and one part of the work which this Committee did was to evolve a performance rating which yielded an index figure known as the Performance Factor, which was directly comparable as between different vehicles, and which admitted of direct determination of grade ability and speeds under any given conditions by the simplest of arithmetic processes. This formula is as follows:

$$\text{Performance Factor} = \frac{3.34 \times \text{Piston Displacement} \times \text{Governed R.P.M.}}{\text{Gross Vehicle Weight, in lb.}}$$

Given a performance factor, the grade ability at a given speed is obtained as follows:

$$\text{Per Cent Grade} = \frac{\text{Performance Factor}}{\text{M.P.H.}} - 1.5$$

Whereas, to determine the speed at which a given grade may be climbed, the formula becomes:

$$\text{M.P.H.} = \frac{\text{Performance Factor}}{\text{Per Cent Grade} + 1.5}$$

For several reasons which need not be discussed at this time, the formula, although widely circulated and published, has never been adopted by the Society, although it is in use by both users and manufacturers to some extent. Nevertheless, it offers important advantages over any other known proposal.

In the first place, it gives an index figure for fair comparison against which no special allowances must be made. It takes account of both tractive effort and speed, and is easily convertible from speed to grade, and from grade to speed. It eliminates manufacturer's claims as to torque, substituting a formula based upon prevailing torque per cubic inch of piston displacement in truck engines. It provides a further correction of torque on the basis of torque developed at governed speed, rather than at the relatively slow peak-torque speed. And finally, the formula is exceedingly simple to use.

Objections which have been made to this formula have been mainly that it is too complicated. These complaints arise from an error which was made in the presentation of the formula for analysis, in that all of the supporting development of the formula was set forth, and many careless readers assumed that all of this mass of figures represented a part of the proposed rating, whereas only the three expressions previously given constitute a part of the proposal. Some who are accustomed to the more abbreviated form of mathematical expression might have been more favorably inclined toward the formula had it been expressed thus:

$$\frac{3.34\,DS}{W}$$

A more serious objection has been raised to the large influence of the factor of engine speed on the result, it being pointed out that passenger-car types of chassis with ungoverned engines which are designed to run at speeds in excess of 3,000 r.p.m., work out to abnormally high performance factors.

Nevertheless, this relation is in agreement with the basic horsepower formula, which is:

$$\text{B.Hp.} = \frac{P\,A\,S\,N\,E}{33{,}000 \times 4}$$

Where P = Mean effective pressure, in lb. per sq. in.
A = Piston area, in sq. in.
S = Piston speed, in ft. per min.
N = Number of cylinders.
E = Mechanical efficiency.

For, if we break down the factor S into its components (R.P.M. and 2 × Stroke), combining the latter with the factors P, A, N, and E, we will have torque, or:

$$\frac{P\,A\,N\,E \times \left\{\frac{2\,L}{12}\right\} \times R}{33{,}000 \times 4}$$

Where L = Stroke in in.
R = R.P.M.

and

$$\frac{P\,L\,A\,N\,E\,R}{33{,}000 \times 6 \times 4} = \text{Hp.}$$

and

$$\frac{T\,R}{63{,}025} = \text{Hp.}$$

Where T = Torque in in-lb.

It must be admitted, however, that the factor of 0.83 of maximum torque, as the torque at governed speed, used in the S.A.E. formula, was based upon a consensus of experience with truck engines, governed at modern speeds. It is not to be expected that a passenger-car engine, at say 3600 r.p.m., will develop 83 per cent of its peak torque. Doubtless a way to work this factor out mathematically will be found and, if the Council in its wisdom sees fit to reconstitute the Rating Committee for the purpose of further efforts to evolve a satisfactory performance rating among other things, then no doubt the present formula can be modified to meet this objection.

Further criticism of the formula has been offered, in view of the fact that it does not take gear reduction or tire radius into consideration, as do the other formulas. This criticism, of course, is due to a misunderstanding, as fundamentally the performance ability of a motor vehicle is a matter purely of the ratio between horsepower and weight, and neither tire diameter nor gear ratios can increase the one nor decrease the other.

The effects of tire radius and gear reduction certainly are contemplated in the formula, for the solution for grade ability is made upon the basis of road speed, and this factor, of course, is the result of these two missing factors. In this connection, the following group of formulas is, of course, most useful:

$$\text{M.P.H.} = \frac{\text{R.P.M.}}{K \times \text{Total Reduction}}$$

and

$$\text{Total Reduction} = \frac{\text{R.P.M.}}{K \times \text{M.P.H.}}$$

(K in the preceding formulas is the r.p.m. of the driving tires per m.p.h., values for which are a part of most standard tire data tables.)

The fact that a given vehicle may not have available a ratio which will give exactly the speed required for a given grade ability under the formula, does not matter inasmuch as, with a speed slightly in excess of the ideal, the torque usually will build up as the grade pulls the speed down to that required, and the vehicle will very closely approximate the performance rated by the formula, notwithstanding.

The primary purpose of dwelling at such length upon this matter of performance formulas is to emphasize the fact that the horsepower-to-weight ratio is the basic fundamental of performance, and that no amount of manipulation of gears or axles can affect this basic relationship to performance ability.

Gear Reduction Range

Nevertheless, although fundamentals are indispensable, alone they are not sufficient, and the matter of gear reduction is without question the most important single factor contributing to satisfactory vehicle performance, excepting the power and torque of the engine alone.

Fallacious notions concerning the effects of different arrangements of gear reductions are rife and, before discussing them, it may be well to state a few basic propositions:

(1) It is the gear-ratio range that counts, regardless of how such range is obtained, range in this case being the spread of total ratios obtainable from the fastest to the slowest speed.

(2) It is the total reduction that is significant of performance, irrespective of how the total reduction is secured, whether by one, two, or three transmissions, by gearing up the propeller shaft and then gearing it down again, or by just gearing down; and regardless of how much or how little of the total reduction occurs in the final drive.

(3) The loaded radius of the driving-wheel tires constitutes a part of the torque-multiplying system, and consequently gear ratio by itself has little meaning, except as related to the effective radius of the tire.

To an engineer, trained and accustomed to think in terms of the fundamentals of fact and physical laws, these propositions should be so self-evident as to be axiomatic; yet, in the products offered by the automotive industry, in the claims made for them through advertising and selling, and in the demands and specifications made by users, they often appear to be utterly ignored.

Overgeared Transmissions

Perhaps one of the most peculiar delusions with respect to gearing is that entertained by a surprising number of people concerning the effect on performance of overgearing in a transmission or auxiliary. The claims made broadly for overgearing are higher schedule speeds, higher fuel economy, and a greater range of ability.

The explanation advanced for these remarkable results is reminiscent of the extravagant claims made for long-stroke engines 25 years ago. In that day, many of the claims for long-stroke engines were based upon a comparison of two engines having equal bores and different lengths of stroke. This, of course, as we now know is an incorrect basis of comparison and, when we compare two engines having the same piston displacement but different bore-stroke ratios, we find that most of the claims for the long-stroke engine evaporate. In just the same way, many of these claims for overgearing are based upon a false comparison.

The only way in which any form of transmission can produce a better schedule speed is:

(1) By providing a faster top speed, or

(2) A faster speed just under top, or

(3) A quicker and easier shift.

In respect to the first two methods, these are simple matters of ratio, and can as easily be provided in a direct-drive transmission as in an overgeared one. As everyone having experience with overgeared transmissions must realize, except where shifting is facilitated by having two speeds very close together, the overgeared shift is more difficult than the direct shift.

The only way in which a transmission can produce better economy or smoother running is to provide more nearly the ideal ratio in top speed, so that satisfactory road speed is obtained without racing the engine unduly. Here again it is obvious that the question is a simple matter of total ratio, and can as easily be secured one way as another. The impression that overgeared transmissions produce greater economy is, no doubt, due to the fact that the comparisons upon which such conclusions are based usually involve different total ratios as between overgeared and direct-geared transmissions, or comparisons of the two in connection with the same axle ratio and so, of course, they are not fair comparisons.

To provide a greater range of ability, a transmission of whatever type must of necessity have a greater range of ratios, and that transmission which has a greater spread of ratios will provide the greater range of ability, regardless of whether its top speed be direct or overgeared.

A series of current popular five-speed transmissions used on trucks between 20,000 and 25,000 lb. gross vehicle weight is shown in the table on the opposite page, first column.

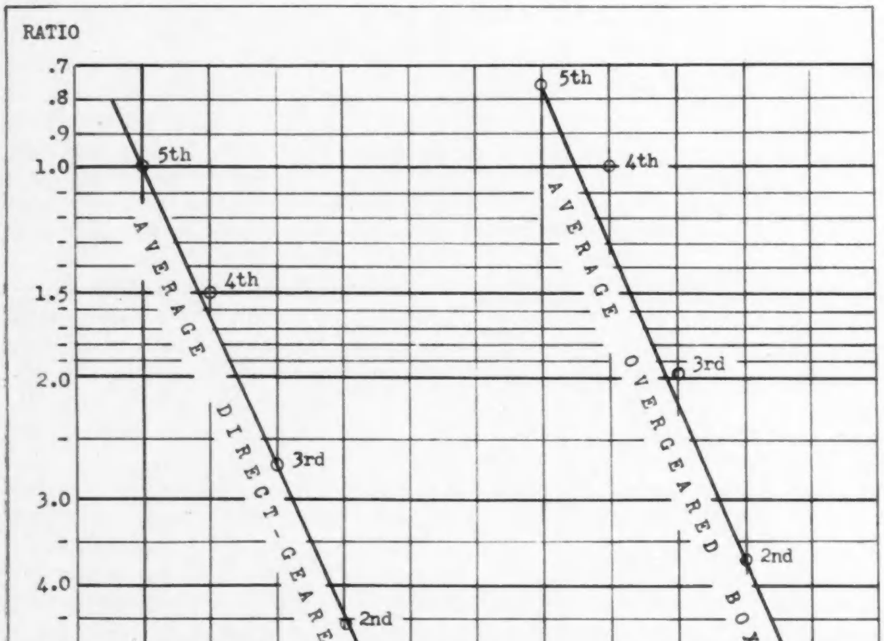


Fig. 1 – Comparison of Ratios of Direct and Overgeared Boxes

Comparing these transmissions, we find that, as a general rule, the ratios in the overgeared transmissions are slightly wider apart at the lower end and slightly closer together at the upper end for, if the ratios are laid out in logarithmic ordinates, as shown in Fig. 1, it will be found that the average of the direct-in-high types adheres much closer to the ideal geometric progression than is the case with the overgeared types. Thus we see that the outstanding difference between present-day direct and overgeared boxes is that the overgeared boxes have about 10 per cent wider range, and that 5th and 4th speeds are closer together. It is these differences which give rise to the popular testimony that (1) with the same maximum speed capability, the overgeared truck is able to make the route in less time because the shift down from 5th to 4th is easier and the truck makes better time in 4th; and (2) that at no sacrifice in low-gear grade ability, the use of the overgeared transmission makes higher maximum speed possible, or a lower engine speed at the same maximum speed.

As a matter of fact, neither of these results has anything whatever to do with whether the top gear is direct or indirect. The first, as a matter of fact, is some-

Direct-geared Transmissions	Ratios in Shifts 5th	4th	3rd	2nd	1st
Box A	1.00	1.42	2.14	4.43	8.08
Box B	1.00	1.45	2.61	4.57	8.05
Box C	1.00	1.41	2.52	4.30	7.53
Box D	1.00	1.40	2.75	4.25	7.35
Box E	1.00	1.48	2.40	4.38	7.58
Box F	1.00	1.73	2.89	4.98	8.11
Box G	1.00	1.75	3.13	5.00	7.35
Box H	1.00	1.43	2.56	4.85	7.70
Box J	1.00	1.42	2.62	4.79	8.07
Average Direct	1.00	1.50	2.72	4.62	7.76

Overgeared Transmissions	Ratios in Shifts 5th	4th	3rd	2nd	1st
Box AA	0.78	1.00	1.89	3.91	7.13
Box BB	0.78	1.00	1.92	3.82	6.74
Box CC	0.77	1.00	2.04	3.48	6.10
Box DD	0.77	1.00	1.86	3.58	6.15
Box EE	0.80	1.00	1.91	3.50	6.06
Box FF	0.79	1.00	1.85	3.29	6.26
Box HH	0.74	1.00	1.70	3.20	6.63
Box JJ	0.72	1.00	1.83	3.52	5.78
Average Overgear	0.77	1.00	1.96	3.54	6.36
Equivalent Direct	1.00	1.30	2.54	4.60	8.25

what debatable. Certainly a shift around a corner, as usually necessary with an overgeared box, is not as easy as a straight-line shift as in making the same change with a direct-geared box. Not only that but, in an overgeared box, the speed of the teeth to be meshed, whether on the gears or on clutch gears, is greater than in the case of the direct-geared box. Against these disadvantages, of course, there is the fact that where, as is often the case, the total difference in speeds is less, it is easier to bring the gears into synchronism.

The second claim for the overgeared box of course has nothing whatever to do with the form of gearing; but is simply and solely the result of a wider range of ratios. As a matter of fact, there are a few straightforward direct-in-high five-speed boxes which have greater ratio range than any five-speed overgeared set.

Compromising between the averages just given, normal equivalent direct-geared and overgeared boxes would be about as follows:

Shift	Direct Ratios	Overgeared Ratios
5th	1.00	0.72
4th	1.39	1.00
3rd	2.50	1.80
2nd	4.60	3.32
1st	8.00	5.75

Transmissions with such ratios as these would give absolutely identical performance if equipped with rear-axle ratios appropriately comparable. For example, supposing that 40 m.p.h. in high gear were demanded, with 9.75-20 tires at 2300 r.p.m.:

Shift	Direct Gearset Ratios (6.46 Axle)	Overgeared Gearset Ratios (8.97 Axle)	Total Reductions	Assuming: 131 Performance Factor 9.75-20 tires 2300 r.p.m. M.P.H.	Per Cent Grade
5th	1.00	0.72	6.46	40.0	1.8
4th	1.39	1.00	8.97	28.8	3.0
3rd	2.50	1.80	16.15	16.0	6.7
2nd	4.60	3.32	29.80	8.7	13.5
1st	8.00	5.75	51.50	5.0	24.7

These are probably the ratios which manufacturers would have developed for direct-geared transmissions if operators had not demanded overgeared transmissions when what they really wanted was wide ratio range and top speeds close together, if sales departments had not conveyed these demands without analysis, and if engineers had not accepted the sales departments' dictums with neither protest nor the offer of an adequate alternative.

Overgeared transmissions have been used by some manufacturers to reduce the required number of rear-axle ratios to meet a given range of speed requirements. Such a method of securing adaptability, however, can be defended neither from the standpoint of service to the owner nor economy to the manufacturer.

Aside from the fact that the overgeared transmission offers no virtues peculiar to itself, there are effects from its use which are usually wholly ignored. In the first place, the overgear results in speeding up the driveshaft above that of the crankshaft. Thus if, say, a 0.75 to 1 overgear is used, the maximum crankshaft speed, which may be 2300 r.p.m., is increased to over 3000 r.p.m. in the driveshaft. Such driveshaft speeds are all very well in passenger cars, whose small and compact joints do not develop very momentous centrifugal forces; but, with the giant joints required for heavy trucks, such speeds spell trouble.

Until the modern era of high engine speeds and overgeared transmissions dawned, the universal joints were accepted as one of those parts which the manufacturer installed and then no one thought of again; yet the universals of that era were crude indeed compared with the finely balanced, timed, and needle-bearing-equipped oil-lubricated joints of today. Rarely has any automotive unit been so suddenly and drastically overhauled and revamped as have our universals, and all because of driveshaft speeds, since the grief on universals seems to increase as some geometric power of their speed.

Of all power losses within transmissions, the greatest is that due to oil churning, and this power absorption increases in greater ratio than the increase in the speed of the gears whose teeth form the paddle-wheels by which it is churned. In overgeared transmissions, it is customary to increase the constant-mesh ratio in order that the normal four-speed change gears may form a step-up without radical change in their sizes. Thus all of the countershaft gears – those which commonly lie almost submerged in the lubricant – are turning at higher speed all of the time and, in addition, those on the splineshaft turn at a speed exceeding that of the flywheel when in overgear.

Perhaps one of the chief drawbacks to the overgeared box is the necessity of using slower rear-axle ratios. This condition involves smaller pinions whose pitch lines, being at a smaller radius, result in higher tooth pressures from the same input torque and, in addition, whose lesser number of teeth means a greater rate of wear. In the case of bevel gears, the

greater the reduction, the flatter the angle on the ring gear, and hence the greater the distorting side thrust on that hard-worked member. This condition contributes to deflection and, consequently, to greater wear and lower efficiency, particularly where backing slippers come into play. Naturally, the higher pinion-bearing speeds for equivalent wheel speeds mean more rapid wear of pinion bearings.

Auxiliary Transmissions

Of course there are transmissions in use which do not have adequate ratio range, either with direct in fifth or in fourth. This condition applies to practically all four-speed transmissions, where heavy loads are carried, where severe roads are encountered, or where operations must be conducted off the road. In such cases, the use of auxiliaries, either in the form of extra transmissions or two-speed axles, are the only alternatives to the use of transmissions of adequate range, but it should be understood clearly that an auxiliary transmission can never be anything other than a makeshift to compensate for inadequate ratio range in the main transmission.

This is by no means to say that the use of auxiliary transmissions is never justified because, in cases where abnormally extreme ratio range is required, it might not be equitable to provide such extreme ranges in a standard transmission, since most truck operators do not require them, and they would unquestionably prove less satisfactory in the majority of operations. In such cases, of course, the auxiliary transmission may be the most logical and economical answer.

In most cases when such units are added, however, the results are far from scientific. Fig. 2 illustrates two such arrangements contrasted with a five-speed box of adequate range. The first of these is a four-speed transmission having but 5.9 to 1 range, in connection with which a three-speed auxiliary, affording a 0.7 to 1 overgear and a 1.935 to 1 undergear, are employed, thus affording 12 forward speeds and an effective range of 16.1 to 1. The second is a straight five-speed box, affording within itself a range of 10.09 to 1. The third is a direct five-speed box having a range of 8.08 to 1, and a two-speed auxiliary, with a 1.47 to 1 undergear, affording a total range of 11.9 to 1, and 10 forward speeds.

As the comparison shows graphically, when set up on a basis of the nearest practicable uniformity in top speeds, most of the gear changes provided are impracticable, and many of them are duplicated; yet claims are made for the first and third of these arrangements which fall but little short of the miraculous. As a matter of fact, the first arrangement gives a practical range of six speeds; the second, of course, five speeds; and the third, six speeds, as follows:

One of the chief limitations as to what can be done with auxiliary transmissions is involved in the matter of tooth pressures, particularly in the driving gears. Users who could not be induced to adopt any makeshift which involved excessive overloading of tires and who would even go so far as to inquire into wheel bearing capacities, are prone to ignore the all-important matter of tooth pressures, and blithely build up high tractive effort by the use of auxiliaries or two-speed rear axles, wholly oblivious of their effect upon the gears. Certain it is that tooth pressure is directly proportional to the torque actually transmitted.

There is no gainsaying that the use of two gearshift levers, when surrounded with the attractive atmosphere suggested by such terms as "double range," "compound," and "dual ratio," has strong driver appeal. Here is a quotation from a recent advertisement of one of these devices:

"Power and *economics* can be definitely multiplied by adding more gear ratios, so that your truck will have a selective speed to meet any road or load condition. . . . You can make faster trips, save oil and gas, save thousands of engine revs hourly, and add tens of thousands of miles to truck life."

Traction

No matter how adequately a vehicle may be powered, or how effectively that power may be applied through the proper number and range of ratio changes, all of this is useless unless it may be applied in the form of tractive effort to overcome the various resistances to motion. This objective involves the matter of traction. Consideration of traction can be greatly complicated by taking into account the effects of transfer of weight between driving and non-driving axles but, for all practical purposes, we may assume that the relative traction ability of various vehicles is in proportion to the percentage of gross weight carried by the driving wheels.

In the days of solid tires, it was quite common to concentrate 80 per cent on the rear wheels of four-wheel trucks, for smooth solid tires were sadly lacking in traction qualities, particularly on wet surfaces. So unfavorable was this load distribution for pneumatic tires and also with respect to axle weight limitations in effect throughout the majority of states, that the trend has been constantly to approach the more equitable distribution of 33 1/3 per cent on the front and 66 2/3 per cent on the rear. Thanks to the splendid traction qualities of pneumatics, particularly the prevailing low pressure type, this distribution has been found to give adequate traction for nearly all applications.

Although the many researches into the adhesion of pneu-

Four-Speed Box & Three-Speed Auxiliary 9.34 Axle – 10.50-24 Tires				Wide-Range Five-Speed Box 7.54 Axle – 10.50-24 Tires				Five-Speed Box & Two-Speed Auxiliary 6.67 Axle – 10.50-24 Tires			
Gear	Final	M.P.H.	Per Cent Grade	Gear	Final	M.P.H.	Per Cent Grade	Gear	Final	M.P.H.	Per Cent Grade
4 OG	6.63	45.4	0.9					5 D	6.67	46.1	0.9
....	....	....	....	5th	7.54	39.8	1.26	....	....	....	....
4 D	9.34	32.2	1.9					5 UG	9.80	31.2	2.0
3 OG	12.14	24.7	3.0					4 D	11.30	27.1	2.6
....	....	....	....	4th	13.71	21.9	3.7	....	....	....	....
3 D	17.18	17.5	4.8					4 UG	16.6	18.5	4.4
4 UG	18.03	16.6	5.1					3 D	17.8	17.3	4.8
2 OG	23.87	12.5	7.3	3rd	24.62	12.2	7.6	3 UG	25.6	12.0	7.7
3 UG	33.15	9.1	10.6					2 D	31.1	10.0	9.5
2 D	33.62	8.9	10.8								
1 OG	39.12	7.7	12.8	2nd	43.10	7.0	12.2	2 UG	45.7	6.7	14.9
1 D	55.10	5.4	19.9					1 D	53.8	5.7	17.8
2 UG	64.89	4.5	28.9	1st	75.98	3.9	26.7	1 UG	79.0	3.9	26.7
1 UG	106.34	2.8	37.8								

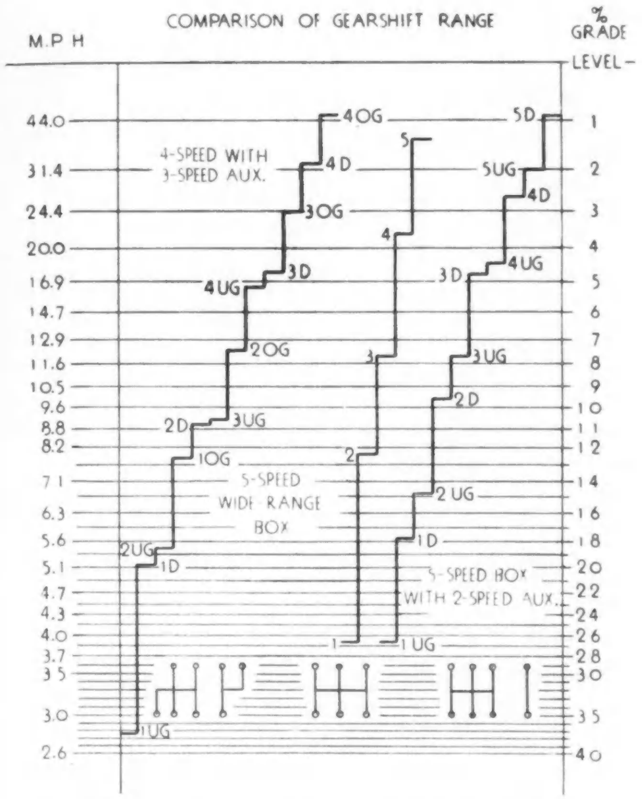


Fig. 2—Comparison of Gearshift Ranges of Five-Speed Wide-Range Box and Two Boxes with Auxiliaries

matic tires upon various types and conditions of road surfaces have yielded extremely conflicting and unstable results, the long-established assumption of a 0.6 factor of adhesion seems to be thoroughly substantiated as an average. Tractive resistance of various surfaces varies greatly, but there is remarkably little difference in their adhesion. This statement, of course, means that a truck may secure traction on any grade up to 60 per cent, provided it has the power applied to all of its wheels. Where the power is applied to the rear wheels only, the grade upon which traction can be secured will be reduced in proportion to the amount of weight carried by the front wheels. This amount will be quite small, however, because the tilting of the truck toward the rear causes a transfer of weight from the front axle to the rear.

Suffice it to say that, on nearly all practicable road surfaces, the modern pneumatic tire affords more traction than is required for the steepest grades actually encountered, so long as the surface is dry. But, when trailers are added or non-driving six-wheel attachments, the percentage of weight carried by the driving wheels is so reduced that traction becomes a factor. This condition is particularly noticeable in snowy and icy weather when it is the custom for haulers on the main routes to lie in wait for four-wheel-driven six-wheelers, with their 80 per cent traction weight, to break the roads for those less able.

Conclusion

In spite of the absurdities and fallacies which pervade the specification and sale of some of these types of construction, nevertheless, with the possible exception of overgeared transmissions where properly designed direct-drive transmissions are available, all of these types have a legitimate sphere of usefulness. Semi-trailers offer advantages with respect to operation under various state laws, in their adaptability to shuttle service, and ready interchangeability of body types, which assure their continued usefulness. Criticisms contained in this paper are not directed against the semi-trailer, but only against its use or sale purely for the sake of increasing load capacity without regard to the effect upon performance.

In the same way, six-wheel attachments are very useful adjuncts where heavy loads are to be carried in states having severe axle-weight limitations. The six-wheel truck also offers advantages in that it permits heavy loads to be equitably distributed among tires without such front-wheel loading as will prejudice ease of steering. Six-wheel vehicles also are known to be extremely safe against skidding and, when all four rear wheels are driven, to possess superior traction qualities.

Auxiliary transmissions have a definite place in the transport picture, both as makeshifts pending the development of transmissions truly adequate for modern demands, and as means of meeting extraordinary requirements as to ratio range.

Before closing I am tempted to advance a suggestion for the simplification of ratio specifications. Equal ratios will give equal tractive effort and speed only when engine r.p.m. and loaded radius of driving tires are equal. Confusion frequently arises, and it is accordingly suggested that, as a true measure of speed reduction, the expression "feet per revolution" be used, meaning the number of feet of forward travel of the vehicle produced by one revolution of the engine, for which the formula is:

$$\frac{2\pi \times \text{Loaded Tire Radius in in.}}{12 \times \text{Total Reduction}} = \text{Feet per Revolution}$$

or, simplified,

$$\frac{0.5236 \text{ Loaded Tire Radius in in.}}{\text{Total Reduction}} = \text{Feet per Revolution}$$

To indicate the application of this conception of reduction, consider two trucks, one of which has an 8 : 1 axle ratio, a 7 : 1 low-gear ratio, and 9.75-20 tires; and the other an 8 : 1 axle ratio, 8:1 in low gear and 9.75-24 tires. Application of the formula shows, substituting for the first truck:

$$\frac{0.5236 \times 18.87}{56} = 0.176434$$

And for the second truck:

$$\frac{0.5236 \times 20.82}{64} = 0.170333$$

Concluding, it is the author's hope that this exploration of the fundamentals of vehicle performance contrasted with the many confused conceptions which prevail in this field, will serve to emphasize how important it is that purchasers of motor transport equipment avoid the specification of the means whereby the desired results are to be obtained and, instead, specify the results which must be secured, in terms of maximum speed in high, maximum grade in low, and simultaneous speed and grade at some intermediate point which might represent the ruling grade upon the route contemplated, leaving the selection of the proper units to accomplish these results to the manufacturer's engineers.

It is very much to be doubted if the many variations of overgeared transmissions and auxiliaries would have been developed if manufacturers had had a free hand in effecting the best solution of each user's problem. Adequate ratio ranges within the compass of standard transmissions, suitable for well over 90 per cent of all applications, can be provided economically by truck manufacturers, which will prove far more serviceable to operators and more convenient to drivers. The makeshift combinations which are in use today, to a very considerable extent, are produced because the industry has not generally caught up to operators' demands. Further advancement will certainly be delayed as a result of the pressure of competition and the mistaken demand of operators if they continue to insist upon specifying not only the results to be obtained but the means by which they are to be produced.

About SAE Members:

William J. Davidson has been named general sales manager of Winton Engine Corp. Prior to this assignment he was technical director under R. H. Grant, vice-president of General Motors Corp., in charge of sales. Mr. Davidson has been with General Motors almost

William J. Davidson
to Winton

continuously since 1914. During the War he served in France with the Motor Transport Corps, United States Army, being discharged with rank of captain in 1919. He later was awarded the Cross of the Legion of Honor of France in recognition of his war service and cooperation with French engineers since the War.

A member of the SAE since 1926, Mr. Davidson has been active in the work of the Society. He is chairman of the Engineering Relations Committee, a member of the Highways Research Committee and represents the Society on the Automotive Upkeep Standards Committee of the American Standards Association.

Alvan Macauley, president of Packard Motor Car Co., and of the Automobile Manufacturers Association, received the honorary degree of doctor of arts in business administration at the commencement exercises of Wayne University, June 17.

Col. A. C. Downey has been named president of Airtemp, Inc., the subsidiary of Chrysler Corp., which manufactures air conditioning equipment. He was previously president of the Fargo Division. Mr. Downey has been associated with Mr. Chrysler since shortly after the World War. He will make his headquarters in Dayton.

Clarence H. Schildhauer, formerly operations manager of the Pacific Division of Pan American Airways System, has been transferred to Port Washington, L. I., N. Y., where he will be operations manager of the Atlantic Division, recently established by Pan American. This division administers flight operations to Bermuda and route survey flights looking toward the establishment of transatlantic air transport service between America, England and Europe. *E. W. McVitty,* who for the past several years has been assigned to Pan American's chief engineer's office, will be division engineer, with headquarters at Port Washington.

Robert Schilling has joined the engineering staff of the Products Study Division of General Motors. He was previously engineer with Olds Motor Works.

L. G. Knapp, former factory manager of Master Electric Co., Dayton, has been named manager of the Sterling Metal Products Co., Indianapolis.

E. B. Newill, who was chief engineer and director of research, has been promoted to assistant general manager, Frigidaire Division of General Motors. He has also been made assistant general manager of the Frigidaire and Delco-Frigidaire Conditioning Division of General Motors Sales Corp.

Gordon Brown, sales manager, Bakelite Corp., New York, has been elected to the board of directors of the newly formed Society of the Plastics Industry.

Hugh James McGinty, St. John division sales manager, Ford Motor Co. of Canada, Ltd., has been transferred to the sales department of the home office in Windsor, Ont.

Karl Feilcke, formerly with the Bendix Products Corp., South Bend, Ind., has been made chief engineer of the Perfection Steel Body Co., Galion, Ohio.

Felix W. A. Knoll is in charge of engineering and production of the Crusader Aircraft Corp., Glendale, Calif. He was previously chief engineer, Chieftain Aircraft Corp., Centerbrook, Conn.

Stuart G. Baits, first vice-president of Hudson Motor Car Co., Detroit, has been named in

Stuart G. Baits
Heads Hudson of Canada

addition president of Hudson Motors of Canada. He will thus add to his duties full active charge of Canadian operations and of the plant in Tilbury, Ont. Mr. Baits has been with Hudson for more than 22 years. He was first employed as a draftsman in 1915, the year following his graduation from the University of Michigan.

B. H. Gilpin, former factory manager of Pratt & Whitney Aircraft Division of United Aircraft Corp., has joined the staff of the Eclipse Aviation Corp., East Orange, N. J.

Vanderbilt Cup Officials

SAE men were active in the judges' stand and the pits at the running of the George Vanderbilt Cup Race at the Roosevelt Raceway on Long Island, July 5.

Heading the list of officials were Vincent Bendix, honorary referee, and David Beecroft, chief steward. Harold Blanchard and Lee Oldfield were, respectively, chairman and vice-chairman of the technical committee. T. E. Meyers was referee.

On the board of judges were Robert A. Stranahan, Grover Loening, D. J. Barrett, George Stowe and Fred Ferguson. Edward V. Rickenbacker was on hand as chairman of the contest board, American Automobile Association.

Included on the technical committee of the A.A.A. were 32 members of the Society who came from practically every automotive center to participate in this event.

Maurice Olley
Transferred to England

Maurice Olley, who has been special problems engineer for General Motors Corp., Detroit, is now in England as passenger vehicle engineer for Vauxhall Motors, Ltd. He was transferred to his new position on July 1. A member of the Society since 1922, Mr. Olley has been active on the Passenger Car Activity Committee and the Riding Comfort Research Committee. He recently presented a paper on riding quality before the Canadian Section.

Robert Boyer, Jr., recently was awarded the 1937 Chance Vought Airplane Design Award for his design of a single-engined transport plane. He was a senior student at the Daniel Guggenheim School of Aeronautics of New York University when the award was made. After graduating he entered the design department of Lockheed Aircraft Corp.

Franklin T. Kurt resigned his position as chief engineer, Viking Flying Boat Co., New Haven, to become associated with the Gilles Aviation Corp. as aviation consultant and in aircraft sales work. He has also taken over the presidency of the Country Club Flying Service, operating at the Aviation Country Club of Long Island.

Col. Edgar S. Gorrell, president of the Air Transport Association of America, recently received the honorary degree of doctor of science from Norwich University, Norwich, Vt., "for devoting his entire time to formulating a solid business foundation for the airlines of America."

L. K. Marshall, general service director, Pontiac Motor Co., and *E. R. Gibbs,* assistant sales manager and chief automotive engineer, Chicago Division, Socony-Vacuum Oil Co., Inc., were among the speakers at a lubrication clinic held in Washington, D. C., late in June. Sponsored by Socony-Vacuum, the clinic was attended by more than 200 service station dealers from five southeastern states.

Walter R. Jones
C. E. of United Air Lines

Walter R. Jones resigned his position as chief engineer, Kellett Autogiro Corp., Philadelphia, to become chief engineer, United Air Lines Transport Corp., Chicago.

. . . . At Home and Abroad

Harry T. Woolson, president of the SAE and Chrysler executive engineer, has been made a member of the National Safety Council's committee to investigate the relation between vehicle speeds and accidents.

Dean H. C. Sadler of the University of Michigan College of Engineering has been granted a leave of absence by the University because of illness.

W. B. Draper, who has been service manager of General Motors, Argentina, Buenos Aires, has been transferred to England, where he will be on the staff of Vauxhall Motors, Ltd.

William H. Funston, Jr., president of the Firestone Tire & Rubber Co., Ltd., Hamilton, Ont., was recently elected president of the Rubber Association of Canada.

A. G. Elliott, chief design engineer of Rolls-Royce, Ltd., England, has been visiting the United States.

James D. Mooney, vice-president of General Motors, has been appointed chairman of the Highways Committee of the Automobile Manufacturers Association.

T. H. Peirce, formerly with Chrysler Corp. as sales engineer, mechanical rubber parts, has joined the H. A. King Co., Detroit, in a similar capacity.

Maurice Platt, long associated with *The Motor,* an English automotive publication, as technical editor, has joined the staff of Vauxhall Motors, Ltd., Bedfordshire. His work will be in the experimental branch of the engineering department. Mr. Platt received his master's degree in engineering from Sheffield University. After the War he was in the experimental department of Albion Motors, Ltd., Glasgow. Prior to that he held a commission in the R.F.C. and R.A.F., becoming a pilot and subsequently a technical officer. He has been a Foreign Member of the SAE since 1929 and is author of two papers which have been presented before the Society.

Maurice Platt
On Vauxhall Staff

Donald L. Bower, chief, planning section, United States Engineer Office, War Department, has been transferred from New York City to Binghamton, N. Y.

On A.S.M.E. Program

Nine SAE members are scheduled to participate in the 10th National Oil and Power Meeting of the American Society of Mechanical Engineers to be held at Pennsylvania State College, Aug. 18-21.

Carl Behn, Harte Cooke, L. M. Goldsmith and Dr. P. H. Schweitzer will preside at technical sessions. Papers are to be presented by C. G. A. Rosen, W. F. Joachim, O. D. Treiber, Martin Schreiber and Gustav Egloff.

Amelia Earhart, heading for Howland Island from Lae, New Guinea, on her round-the-world flight, on July 2 radioed that her plane's fuel was nearly exhausted within 100 miles of that destination. As this issue goes to press, sixty planes from the U. S. S. Lexington are in the final phase of search for the great aviatrix and her pilot, Fred J. Noonan.

Miss Earhart joined the SAE in 1930, has talked before its meetings on more than one occasion and has frequently been helpful in furtherance of aircraft projects of the Society.

Pan Pacific Press Bureau Photo

E. W. Burke, aviation cadet, United States Navy, has been transferred from the Fleet Air Detachment, Coronado, Calif., to the Naval Air Station, Norfolk Va.

George H. Lancaster has joined the Tide Water Associated Oil Co. Bayonne, N. J., as experimental engineer. He was formerly test engineer with the Wright Aeronautical Corp., Paterson, N. J.

Lessiter C. Milburn has joined the Curtiss-Wright Corp., St. Louis division, as works manager. This change follows more than 15 years with the Glenn L. Martin Co. of which he was vice-president and director. He holds numerous patents for airplane mechanical devices and the U. S. Patent office has granted him design patents on the *Martin Bomber,* the *China Clipper* and a new type of high-altitude transport plane. Mr. Milburn will be located in Robertson, Mo.

Lessiter C. Milburn
Joins Curtiss-Wright

T. A. Weir, engineer, Socony-Vacuum Oil Co., Inc., in Paris, sailed for a visit to this country early last month. Mr. Weir was one of the Society's representatives at the World Petroleum Congress which met in Paris, June 14 to 19.

C. B. Veal, manager of the SAE Research Department, who has been representing the Society at a number of important gatherings in Europe, attended the 75th annual meeting of the Society of German Engineers (V.D.I.) at Kiel early last month.

Robert C. McGuire has joined the staff of United Air Lines. He will be located in Chicago.

Charles I. Preston is with the St. Louis Division of Curtiss Wright Airplane Co., Robertson, Mo., engaged in powerplant installation work. He was formerly with Allis-Chalmers Manufacturing Co.

William B. Wheatley, chief test pilot and service manager, Consolidated Aircraft Corp., was one of the pilots who flew the first flying boat to make a non-stop transcontinental flight from San Diego Bay to Long Island Sound, adjacent to North Beach Airport, New York, June 24-25. The ship is a commercial PBY-1 Consolidated flying boat and Mr. Wheatley was aboard as chief pilot for the manufacturer. Official time was 17 hr. 3 min. 30 sec.

The plane is owned by Richard Archbold, research associate of the American Museum of Natural History, and will be used in flights in connection with research in New Guinea. Beside Mr. Archbold, who is himself a pilot, and Mr. Wheatley, there were four other members of the crew.

SAE Members Abroad

O. E. Hunt, vice-president, General Motors Corp.; Hans Wollner, chief engineer of Universal Products Co., Inc., and Peter M. Heldt, engineering editor of ***Automotive Industries,*** are visiting Europe. Mr. Hunt sailed on July 7 and plans to return early this month; Mr. Heldt departed July 1 to remain abroad until September, and Mr. Wollner expects to visit several countries before his return.

Yrjo Leiviska, Helsinki, Finland, has been granted the title of barrister at law by the Court of Appeal in Viipuri.

Frederick C. Brandt is in the Sundstrand Machine Tool Co., Rockford, Ill., pump department as tool engineer. He was designer of special machinery with Reynolds Engineering Co., Rock Island, Ill.

Joseph A. Doyle, who was junior traffic engineer and vehicle inspector, Chicago Park District, has joined the Bendix Products Corp., as traveling dynamometer engineer. He will make his headquarters in South Bend, Ind.

R. H. Pennebaker is lubrication engineer with the Lion Oil Refining Co., El Dorado, Ark. He formerly held a similar position with the Carter Oil Co., Tulsa, Okla.

WILLIAM LITTLEWOOD, *chief engineer of American Airlines, Inc., and recipient of the 1935 Wright Brothers Medal, is reported to have interested two large fountain pen manufacturers in developing an altitude-proof pen, according to* AVIATION. *Anyone who has ever tried to open and use his fountain pen at 10,000 ft. will appreciate Mr. Littlewood's efforts.*

Ralph S. White has been made associate engineer in the Airworthiness Section of the Bureau of Air Commerce, Department of Commerce, Washington, D. C. He was previously experimental engineer with Aviation Manufacturing Co., Williamsport, Pa.

Robert L. LaChapelle has joined the faculty of Washington High School, Sioux Falls, S. D., as instructor in auto shop and related subjects. He formerly taught the auto class in the vocational school of the Minnesota State Reformatory.

I. L. Carron, body engineer with the Dodge Division of Chrysler Corp., has been appointed instructor in body design and professor of law in the Chrysler Institute of Engineering. In addition to being an engineer, Mr. Carron is also an attorney-at-law, having been admitted to the bar in 1930. He is active in the Detroit Section and has been elected 1937-1938 vice-chairman representing its passenger-car body activity.

I. L. Carron
Instructs

William L. Batt, president of SKF Industries, presided at a recent dinner at which it was announced that the Seventh International Management Congress will be held in Washington, D. C., in September of 1938. Mr. Batt is chairman of the coordinating committee of the Congress.

Ralph E. Flanders, president, Jones & Lamson Machine Co., is chairman of the production section for this Congress.

Capt. Lawrence E. Heyduck, 83rd Field Artillery, U. S. Army, has been transferred from Fort Sill, Okla., where he was instructor in maintenance and operation at the Field Artillery School, to Fort Banning, Ga., where he is stationed as motor supply officer and maintenance and operation officer.

Dr. Ferdinand Porsche, designer of the Auto-Union cars finishing first and fourth in the George Vanderbilt Cup Race, July 5, was in the United States for the event. He returned to Germany on July 16.

C. R. Osborn has been appointed general manager of Adam Opel A/G, German affiliate of General Motors. He was formerly assistant general manager. Mr. Osborn has been associated with G.M.C. since 1916.

Norman W. Smith

Norman W. Smith, sales engineer of Permold Co., was killed in an automobile accident, June 13. His wife, who accompanied him in the car, was seriously injured.

Mr. Smith had been affiliated with the Permold Co. since 1930. Prior to that he was foundry superintendent for the Taylor & Boggis Foundry. He joined the SAE a little more than one year ago. At the time of his death he was 36 years old.

SAE *Coming* EVENTS

Cleveland Section Regional Tractor Meeting
Sept. 15-17
Mayflower Hotel
Akron, Ohio

Chicago Section Regional Transportation Meeting
Sept. 29-Oct. 1
Blackstone Hotel
Chicago, Ill.

Fuels and Lubricants Regional Meeting
Sept. 30 & Oct. 1
Mayo Hotel
Tulsa, Okla.

National Aircraft Production Meeting
Oct. 7-9
Ambassador Hotel
Los Angeles, Calif.

Annual Dinner
Oct. 28
Commodore Hotel
New York

National Production Meeting
Dec. 8-10
Hotel Durant
Flint, Mich.

Annual Meeting
January, 1938
Detroit, Mich.

Student Members Start Work in Automotive and Allied Industries

Wilfred Pearce and *David L. Lindsay,* formerly student SAE members attending the University of Oklahoma, have advised the Society that they are now employed. Mr. Pearce has taken a position as draftsman with the Stearman Aircraft Co., Wichita, Kansas, and Mr. Lindsay is draftsman with the Hughes Tool Co., Houston, Tex.

Duis W. Miller, who was a student member at New York University, has started as assistant in the woodworking factory of Beech Aircraft Corp., Wichita.

William J. Conway, a recent graduate from the aeronautical department of the University of Detroit, is now with the Bell Aircraft Corp., Detroit.

James L. Dooley is student engineer with Ingersoll-Rand Co., San Francisco. He was formerly a student at the University of California, Berkeley.

Richard G. Karch, a member of the SAE Student Branch at Massachusetts Institute of Technology, has joined the Gulf Oil Corp. as planning and time study engineer. He will be located at Port Arthur, Tex.

Charles W. Gadd, an enrolled student at Massachusetts Institute of Technology, is now located at the R.O.T.C. Engineer Camp, Fort Belvoir, Va.

Robert W. Zinn, who was secretary of the Ohio State University SAE Student Branch during the winter quarter, 1936, has joined the Superior Engine Division of the National Supply Co., Springfield, Ohio.

Ralph D. Powers, a former student at the University of California, is a member of the student engineering training course of Harnischfeger Corp., Milwaukee.

William J. Danner is apprentice engineer with the Chevrolet-Muncie Division of General Motors Corp., Muncie, Ind. He was formerly a member of the SAE Student Branch at Purdue University.

Ralph D. McGilvra, formerly a member of the SAE Student Branch at Oregon State College, has joined the Coeur D'Alene Hardware & Foundry Co., manufacturers of mining equipment, at Wallace, Idaho, as junior engineer.

David L. Gundry, a former member of the SAE Student Branch at Massachusetts Institute of Technology, is working in the experimental laboratory of the White Motor Co., Cleveland.

John M. Stevenson, a recent graduate from Texas Agricultural & Mechanical College, has joined the Allis-Chalmers Manufacturing Co., Milwaukee.

Announcing 3 SAE MEETINGS

1. Tractor—*Akron*
2. Transportation—*Chicago*
3. Fuels & Lubricants—*Tulsa*

Section Regional

Tractor Meeting

Sept. 15 - 17

AKRON is the rubber city. Tractor tires will be the theme of the meeting to be held there at the Mayflower Hotel. An important paper is scheduled on electric welding and its part in the manufacture of tractor wheels and rims. Trips to tire plants, demonstrations and the "Rubber Industry" dinner will add to the interest-generating program of technical sessions.

Sponsored by the Cleveland Section the meeting will have the cooperation of the Tractor and Industrial Power Equipment Activity and Akron's tire manufacturers.

The Goodyear-Zeppelin dock will be the scene of tractor tire testing demonstrations. Scheduled trips include inspection tours of the Goodyear, Goodrich and Firestone plants.

Section Regional

Transportation Meeting

Sept. 29 - Oct. 1

WHEN transportation men gather in Chicago for this three-day meeting they will find an outstanding program of technical sessions and field trips scheduled by the Chicago Section with the cooperation of the Transportation and Maintenance and the Truck, Bus and Railcar Activities. Sessions will be held at the Blackstone Hotel.

First drafts of the program forecast papers on such vital subjects as Truck Ratings, E-P Lubricants from the Wear Standpoint, Economies of Undersizing and Re-treading Tires, Heating and Ventilating of Buses, and Steam Railcars.

One of the field trips will be to the Electromatic Products Co. More are being planned to include other important Chicago plants.

National Regional

Fuels & Lubricants Meeting

Sept. 30 - Oct. 1

MODERN Tulsa, in the heart of the oil country, will welcome fuels and lubricants men to this two-day gathering in the air-conditioned rooms of Hotel Mayo.

General Chairman B. E. Sibley and his committees have worked in close cooperation with Vice-President C. H. Baxley and the Fuels & Lubricants Activity to build a carefully balanced program.

Diesel Fuels and Gasolines . . . Engine Cooling . . . Transportation and Maintenance Problems . . . Aircraft – are all a part of this forum that will be topped off by a debate "The Diesel Engine Vs. the Gasoline Engine for Automotive Applications." University of Oklahoma and Tulsa University debaters will be the principals.

Programs Will Be Out Early in September

News of the Society

Field Editors

Baltimore – Espy W. H. Williams
Buffalo – G. W. Miller
Canadian – Warren B. Hastings
Chicago – Austin W. Stromberg
Cleveland – William G. Piwonka
Dayton – Mearick Funkhouser
Detroit – William F. Sherman
Indiana – Harlow Hyde
Kansas City – No Appointment
Metropolitan – Leslie Peat
Milwaukee – Max Hofmann
New England – J. T. Sullivan
No. California – C. W. Spring
Northwest – R. J. Hutchinson
Oregon – Philip Cogswell
Philadelphia – Henry Jennings
Pittsburgh – Murray Fahnestock
St. Louis – C. T. Schaefer
So. California – W. G. Chamberlin
So. New England – John G. Lee
Syracuse – No Appointment
Washington – Capt. E. L. Cummings

C.O.E. Trucks Analyzed From Different Angles

● So. California

The cab-over-engine truck was the subject of four of the five papers presented at the June 18 transportation meeting of the Southern California Section. The fifth paper, by A. H. Chenault and Frank R. Elliott, both of Ethyl Gasoline Corp., described the "Elliott Independently-Driven Supercharger," which was on display. It was explained that the Elliott supercharger consists of a conventional supercharging unit by an auxiliary gasoline engine, permitting the supercharger speed and/or pressure to be varied independently of the truck speed, thus providing any desired pressure at any time.

B. B. Bachman, Autocar vice-president and chief engineer, was author of the paper, "Engineering Facts in Support of the Camel-Back Truck," read by G. C. Phillips, secretary to the vice-president and district sales manager of Autocar Sales and Service Co. of California.

Defining the cab-over-engine truck as one in which the engine is mounted adjacent to the front end of the chassis ahead of the front axle, and the engine-under-seat type as having the powerplant mounted directly under the driver's seat, occupying approximately the same relative position as it does in the conventional vehicle, Mr. Bachman explained that first type is generally used for light trucks and the latter for heavy-duty units.

Shorter overall length, he said, is one decided advantage in either of these designs due to the increasing density of traffic and the imposition of truck-length regulations. Other features of these trucks include, he said, ability to turn in a small radius, ease of obtaining proper weight distribution, reduced frame stresses through relocation of various units made possible by this design, distinctive appearance and greater driving comfort through better ventilation, better vision, easier driving and better riding qualities.

Casey Jones, sales manager of the Southern California Division of Federal Motor Truck Co., read a paper "Door Location—Fore and Aft or Aft of the Front Axle," prepared by E. W. Winans, Federal chief engineer. Mr. Winans advocated that the door be located to the rear of the axle because "it provides a better ride, better visibility fore and aft, easier steering due to less front-axle loading, more accessible engine from a service standpoint, direct transmission and hand-brake controls and, last but not least, with this design it is possible to build the cab separate from the front part, thus expediting the building of special bodies and greatly decreasing their cost."

Two papers previously presented at the Society's Summer Meeting were read, with certain revisions to include changes since that time. "Maintenance of C.O.E. Trucks vs. Conventional Trucks," by Robert Cass, assistant chief engineer, White Co., was read by Gene E. Etzler, Los Angeles district service manager for the same company. Pierre Schon's paper, "The Place of C.O.E. Trucks in Transportation," was read by P. Sonna. Mr. Schon is transportation engineer, General Motors Truck & Coach Division of Yellow Coach & Truck Manufacturing Co., and Mr. Sonna is retail sales manager for General Motors Truck & Coach Co. in Los Angeles.

Most of the papers were illustrated with slides and motion pictures. Eighty-three members and guests attended the dinner and many more came in afterward to hear the papers. Because of the length of the program there was no discussion.

Among the guests at the meeting was Lieut. Harlan Knox Perrill of the U. S. Navy, an SAE member, who had just returned from a nonstop flight to Honolulu.

Gavel Presented to Retiring Section Chairman

Photo by SAE Journal Field Editor W. G. Chamberlin

● So. California

Larry J. Grunder receives from E. Power the gavel donated by members of the Southern California Section as a token of their appreciation of his work as Section chairman during the past year.

In the background, *from left*, are: Melvin N. Lefler, secretary; E. W. Templin, chairman of the transportation and maintenance committee; Charles H. Jacobsen, chairman of legislation and regulation committee; Charles E. Paxton, chairman of student activity, and John W. Mountain, secretary of the Automotive Council. The presentation was made at the Section's June 18 meeting.

Concentric or Eccentric?

The Society has just been requested to develop a standard definition for eccentricity or concentricity tolerances, the method of expressing them and the resultant indicator readings.

In the request it is stated that, for example, in laying out a sleeve bearing, one group of engineers may specify "concentric within 0.0005 in." A different group will specify "concentricity 0.0005 in." and still another group will specify "eccentricity 0.0005 in." This indefiniteness of expressing the tolerances frequently is confusing in determining the amount of indicator run-out that should be allowed. The problem has been referred to the Standards Committee for clarification.

(*Continued on page* 25)

News of the Society

(*Continued from page 24*)

Elected Production Vice-President

William B. Hurley has been elected by the Council as Vice-President of the Society representing the Production Activity, to fill the unexpired term of the late Robert R. Keith. Mr. Hurley was Vice-Chairman of the Production Activity Committee before being named Mr. Keith's successor. He is also a member of the Membership Committee and has held several Detroit Section offices.

Mr. Hurley is sales engineer with Detroit Edison Co. and in that capacity is in close contact with production men in the Detroit area. He is a graduate of the University of Michigan. From 1919 to 1931 he was affiliated with Dodge Bros. in various production capacities.

Worries Forgotten on Cruise to Charlevoix

● Detroit

The good ship South American took 175 members and guests of the Detroit Section for a gala holiday to Charlevoix, Mich. Leaving Detroit on Friday, June 25, worries were forgotten until return to the city Monday morning in time for work.

Golf was the order of the day at Charlevoix. S. C. Merrill, Detroit district manager of sales, Timken Roller Bearing Co., won the first prize in the men's golf tournament, blind par 70-80. Cass Russell, sales engineer, Victor Manufacturing & Gasket Co., took the second prize. Other sporting events included a ladies' golf tournament, a kickers' tournament for men and bridge.

During the stop at Mackinac Island the ardent golfers managed to squeeze in a round while others passed the time bicycling and engaged in less strenuous activities.

Subdivision Approves Trailer-Hitch Standard

The standard for touring-trailer couplings is ready for approval by the passenger-car division of the SAE Standards Committee. Prepared by the subdivision on touring trailers, recommendations were first presented at the subdivision's January meeting (see p. 54, Feb. SAE JOURNAL), and later approved, with revisions, at its June 28 meeting, at which representatives of touring-trailer manufacturers were present. Following approval by the passenger car division, the standard will go to the Standards Committee for consideration before reaching the Council for final approval and adoption as SAE Standard.

The recommendation limits the standardization program to include only trailers that are towed by passenger cars and the type of coupling that is attached to the rear of the towing vehicle.

"Trailer hitch" is defined as that part of the connecting mechanism, including the coupling platform, that is attached to the towing vehicle. The "coupling" is that part of the connecting mechanism by which the connection is actually made and includes the supporting mechanism back to the trailer frame.

Two sizes of coupling connections are provided, No. 1 for trailers having a gross weight of up to and including 5000 lb., and No. 2 for trailers of over 5000 lb.

Coupling No. 1 is to have longitudinal tension and compression strength of 15,000 lb. and vertical tension and compression strength of 7000 lb. Coupling No. 2 is to have twice these strength values.

No coupling is to be connected to the rear bumper of the towing car except where bumper is specifically designed to carry the coupling unit, and the coupling unit is to be located ahead of the face of the bumper to allow a minimum clearance of 3 in. between the bumper bar and the coupling unit.

For both coupling sizes the coupling platform attached to the towing vehicle is to be of steel one-half inch thick at the hole for the coupling unit or stud and the drilled hole is to be 1 in. diameter with suitable tolerances.

The upper face of the platform to which the coupling unit is attached is to be substantially horizontal and 19 in. above the ground level, with tolerance of 1 in. up or down.

It was generally agreed at the meeting that the general coupling arrangement will be considerably improved in the next few years and that because of these expected developments the recommendations may be more or less transitory. Accordingly the subdivision called attention to the importance of not including specific recommendations in regulatory legislation, and leaving the way open for revisions as rapidly as adopted.

Trailer manufacturers attending the meeting indicated their desire that the SAE continue its cooperation in developing further engineering standards for this type of trailer. Several suggestions, including among others a study of brakes and braking connections, lighting equipment, and weight ratios between axles and the couplings were scheduled.

Members of the committee and others interested in this work are submitting additional suggestions for trailer and trailer equipment standardization.

More E-P Lubricants Machines on the Way

To meet a demand for additional SAE Extreme-Pressure Lubricants Testing Machines, the executive committee of the Extreme-Pressure Lubricants Committee has authorized building a new lot. Orders are being accepted and production will start at the earliest possible date.

This new batch will be of the same design as those already in use. However, the committee states, that while it considers the principle upon which the design is based is correct and acceptable, the machine has not been approved as a standard instrument, and it may not be in its present form. Design changes may be made later with the result that the machines already in use and those to be produced in the new lot may require the purchase of certain minor parts at a somewhat later date.

All orders for the machine should be addressed to the Research Department, Society of Automotive Engineers, 29 West 39th Street, New York. They must be approved by the executive committee before acceptance. To date machines have been assigned only to those companies willing to cooperate with the committee to a reasonable extent in the running of tests looking toward the development of the machine and methods of test.

The price of the last lot of machines was $650 each, including mechanical inspection operating tests prior to shipping. It is expected that the price of those in the new lot will be substantially the same. They will be built by the Highway Trailer Co., Edgerton, Wis.

S.I.A. Host to SAE Delegates in Paris

SAE delegates attending the Second World Petroleum Congress in Paris, June 14-19, were entertained at a luncheon by the Council of the Société des Ingénieurs de l'Automobile at the Automobile Club of France on June 18, upon the invitation of S.I.A. President Pierre Prévost. On the evening of the same day they attended an informal meeting on the subject of detonation at the S.I.A. headquarters.

Attending both functions were SAE Fuels & Lubricants Vice-President, C. H. Baxley, International Aviation Associates; Dr. George Calingaert, Ethyl Gasoline Co.; T. A. Weir, Socony-Vacuum Oil Co., Paris; and SAE Research Manager C. B. Veal. Mr. Weir has made many Paris arrangements for the American delegates that have contributed to the enjoyment of their stay in that city. Alex Taub, Vauxhall Motors, Ltd., another member of the SAE delegation, was unable to attend.

Other guests at the luncheon were Inspector-General of the French Air Ministry Dumanois and G. D. Boerlage, manager of the Delft (Holland) Laboratory of the Royal Dutch Shell

(*Continued on following page*)

Group, a Foreign Member of the Society who has prepared a number of papers for SAE meetings.

At the evening meeting there were more than 40 members of the S.I.A. and the SAE present. M. Charles Bernard Brull, a member of both Societies, presided. After members of the SAE delegation were introduced Mr. Boerlage gave a bi-lingual description of the recent detonation research carried out in the Shell laboratory at Delft. M. Serruys of the French Air Ministry commented at length on Mr. Boerlage's talk and his own detonation studies. Dr. Calingaert contributed to the discussion in both French and English.

Iso-Octane Specification

A specification intended to limit the impurities allowable in the iso-octane, 2, 2, 4-trimethylpentane, certified for use as a primary standard for knock rating has been proposed by the C.F.R. Reference Fuels Committee as a result of a study conducted at the United States Bureau of Standards. Its adoption is subject to a letter ballot being circulated among members of the C.F.R. Motor Fuels Committee.

Plan to Extend Scope Of SAE Spring Standard

Review of the SAE specification for leaf springs has led to definite arrangements for bringing it up to date by eliminating obsolete data and bringing the specification into accordance with modern practice. This work is being undertaken by the subdivision on suspension springs recently appointed under the passenger car division of the SAE Standards Committee.

Data on the coil type of suspension springs used in knee action, and on grooved spring blades are also being studied in anticipation of adding specifications for these items to the revised standard.

Tore Franzen, experimental engineer, Chrysler Corp., heads this subdivision which is made up of representatives of motor-vehicle manufacturers and principal spring companies.

When these specifications have been completed and approved by the Society they will be included in the SAE HANDBOOK as a general standard for suspension springs, replacing the present standard (p. 81, 1937 HANDBOOK) which relates only to leaf or flat springs.

Pitchford Explains

After reading the news story of the Second Diesel Session of the 1937 Semi-Annual Meeting at White Sulphur Springs, J. H. Pitchford, Ricardo & Co., makes the following comments in order to correct any misunderstanding as to his review of the Diesel situation in Europe:

"I am reported to have said that the maximum mean effective pressure for bus work is 123 lb. per sq. in. This figure is, of course, the maximum obtainable on a research engine, and the actual torque to which the engine is limited in service is of the order of 97 lb. per sq. in.

"In another paragraph it is mentioned that I spoke of German air-cooled Diesels – with the intimation that Junkers engines were air-cooled. This impression is, of course, a mistake, since all the Junkers Diesel engines are water-cooled."

Both comments refer to statements made on page 42 of the June, 1937 issue of the SAE JOURNAL.

Wide Participation in Knock-Rating Tests

Reports submitted by the 19 companies co-operating in the winter series of tests for knock rating of fuels on the road, under guidance of the C.F.R. Motor Fuels Committee, have been compiled and are awaiting analysis to be made after Aug. 15 when reports of the summer series will also have been received. Participation in these tests has been wider than ever before and indications are that the data will be more complete than in any program yet undertaken in detonation testing.

Eighty-four different cars were used and a total of 1084 ratings have been submitted on 19 fuels at atmospheric temperatures between 20 and 80 deg. fahr.; 80 per cent at temperatures below 50 deg.

The Laboratory Group has undertaken to test 10 preferred fuels and, if possible, all of the winter series of fuels by 21 different combinations or modifications of test conditions consisting of mixture temperature, spark advance and speed.

The Exchange Group obtained laboratory knock ratings on the winter series test fuels during the month of July and will obtain knock ratings of the summer series during August.

Revisions of the present road test procedure that have been made by the Road-Test Planning Group incorporate certain refinements consisting mainly of more detailed specifications for servicing the test cars, particularly with respect to ignition timing.

The C.F.R. Motor Fuels Committee referred to above has replaced the C.F.R. Subcommittee on Methods of Measuring Detonation. Its scope now includes studies of volatility as well as detonation.

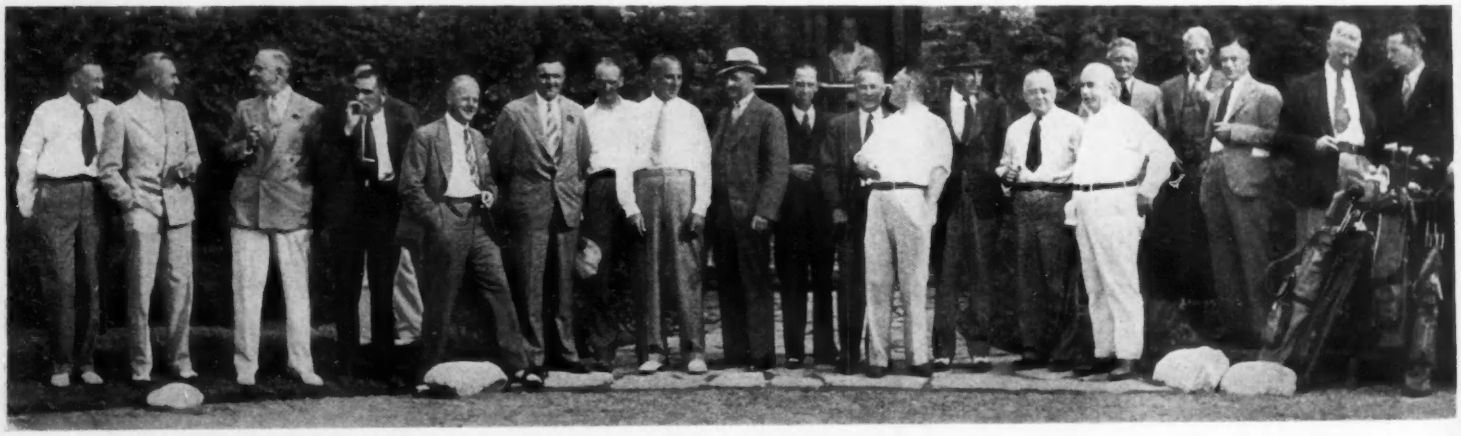
Gasoline Report Available

The report of the C.F.R. Motor Gasoline Survey, Winter 1936-1937, has been approved by the C.F.R. Committee and published by the United States Bureau of Mines which cooperated in making the survey. It includes an analysis of samples of gasoline sold at retail by service stations throughout the country during the period of the study.

Copies of the report may be obtained, without cost, from the Bureau of Mines.

The Summer 1937 Gasoline Survey is now under way.

56 Win Golf Prizes At Annual Canadian Section Tournament



Bright skies welcomed members and guests of the Canadian Section to the Royal York Golf Club, near Toronto, for the Section's Annual Golf Tournament, June 25. Termed the "biggest and best ever to be held," it was followed by a progressive dinner at which 56 prizes were distributed.

Fred G. Hoblitzel created a sensation by turning in a course-record-shattering 67. This earned him the Canadian Raybestos prize. R. H. Combs, bettered the scores of all other past-chairmen to be the first to have his name inscribed on the "Tiny" Houston Gold Memorial Trophy, put up by the Section to "commemorate the memory of one who had served the Section and especially the Golf Tournament Committee so well." It will be competed for by Section past-chairmen each year.

A. W. Hopton won the Prest-O-Lite Trophy for low net for members and Albert Olson the Seiberling Trophy for second low net for members. The SKF Trophy for low gross for members went to F. A. Sharpe and, as runner-up in this division, J. C. Armer received the Acme Screw and Gear Trophy.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between June 15, 1937, and July 15, 1937.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

BARFOD, ANKER LIND (A) body designer, draftsman, Fisher Body Co., Division General Motors Corp., General Motors Research Bldg., Detroit, Mich. mail 349 Monterey Ave., Highland Park.

BARNARD, NORRIS C. (A) wholesale sales, Colonial Beacon Oil Co., 30 Rockefeller Plaza, New York City (mail) 803 Boulevard, Westfield, N. J.

BLANK, H. E., JR. (J) assistant editor, Chilton Co., 56th and Chestnut Sts., Philadelphia Pa. (mail) 5436 S. Fairhill St.

BRISSON, LOUIS CHARLES (F M) chief engineer, Societe des Freins Hydrauliques S. de Lavaud, 4 Rue Teheran, Paris, France.

BROWN, WILFRED E., JR. (J) research associate, Harvard Traffic Bureau, Harvard University, 29 Holyoke St., Cambridge, Mass.

CITROEN, LOUIS (A) assistant to general manager, Societe des Petroles Jupiter, 42 rue Washington, Paris, France (mail) 7 rue Decamps, Paris 16e, France.

COOPER, FRED E. (A) owner, Post Office Box 1890, Tulsa, Okla.

COPELAND, FLOYD B. (M) sales engineer, Detroit representative, Doehler Die Casting Co., Smead and Prospect Ave., Toledo, O. (mail) 4556 Manorwood Road.

CRANE, WALTER JACKSON (J) Pacific Highway Transport Co., Seattle, Wash. (mail) 1122 Columbia St.

DRUMMEY, JOHN FRANCIS (A) sales manager, Morganite Brush Co., Inc., 3302-48th Ave., Long Island City, N. Y.

DUNHAM, THOMAS M. (A) president, Aurora Equipment Co., Aurora, Ill.

ERICKSON, R. O. (A) manager, lubrication and industrial department, Shell Petroleum Corp., 904 Griswold Bldg., Detroit, Mich. (mail) 7602 Freda, Dearborn, Mich.

FOLTZ, WARREN D. (J) representative, Bendix Westinghouse Automotive Air Brake Co., 5001 Centre Ave., Pittsburgh, Pa. (mail) 845 Railway Exchange Bldg., Chicago, Ill.

GRAHAM, JOHN A. (A) president, Motor Improvements, Inc., 365 Frelinghuysen Ave., Newark, N. J.

HALLER, FREDERICK E. (A) treasurer, Mt. Lebanon Garage Co., 600 Washington Road, Mt. Lebanon, Pa.

HANSON, GEORGE (J) engineer, assistant to manager, road machinery division, Southwest Welding & Mfg. Co., 3201 W. Mission Road, Alhambra, Calif. (mail) 5060 Coringa Drive, Highland Park, Los Angeles, Calif.

HELLING, CHARLES HAROLD (J) order clerk, parts department, E. A. Wildermuth, 1102 Atlantic Ave., Brooklyn, N. Y. (mail) 3432 Fulton St.

HEM, LAWRENCE WM. (M) tutor, mechanical engineering, College of City of New York, School of Technology, 139th St. and Convent Ave., New York City.

HOBELMANN, ALFRED HERMAN (A) sales engineer, Walter Kidde & Co., Inc., 140 Cedar St., New York City. (mail) 4803 Langdrum Lane, Chevy Chase, Md.

HOENER, S. T. (A) research and foreman, International Harvester Co., 2626 W. 31st Blvd., Chicago, Ill.

HUNT, DAVID ELDRIDGE (J) 66 Chickatabot Road, Quincy, Mass.

INBLUM, ALLEN JOHN (A) vice-president, Pittsburgh Auto Spring Co., 5900 Centre Ave., Pittsburgh, Pa.

KELLER, GEORGE H. (J) research assistant, mechanical engineering laboratory, Pennsylvania State College, State College, Pa.

KUHNE, PAUL K. (M) supervisor, Gulf Oil Corp., Refinery Technology Div., Post Office Box 7409, Philadelphia, Pa.

LANAGAN, W. P. (M) president, Lanagan & Hoke, Inc., 1638-40 W. Hunting Park Ave., Philadelphia, Pa. (mail) 3336 Aldine St.

LARSEN, NEIL P. (A) vice-president, charge of sales, American Coach & Body Co., 9303 Woodland Ave., Cleveland, O. (mail) 3513 Silsby Road, Cleveland Heights, O.

LEATHERS, L. A. (A) owner, L. A. Leathers Co., 200 Madison Ave., Brookville, Pa.

MACKECHNIE, THOMAS HUGH (M) motor vehicle superintendent, Southern California Telephone Co., Room 702, 740 S. Olive St., Los Angeles, Calif.

MANVILLE, WILLIAM WINDECK (J) graduate student, Rensselaer Polytechnic Institute, Sage Ave., Troy, N. Y.

MARETTE, RALPH THOMAS (J) Case School of Applied Science, Mechanical Engineering Bldg., University Circle, Cleveland, O.

MARSHALL, EDWARD COWAN (J) development engineer, Wallace & Tiernan Co., Inc., Newark, N. J.

MAY, WILLIAM ARTHUR HENRY (F M) manager, Sao Paulo Branch, Thornycroft do Brazil S.A., 2960, Caixa Postal, Sao Paulo, Brazil, South America.

MCBRIEN, R. L. (J) engineer, flight research, United Air Lines Transport Corp., 5936 S. Cicero Ave., Chicago, Ill.

MCCLELLAND, EDWARD W. (A) sales representative, Shakeproof Lock Washer Co., 2501 N. Keeler Ave., Chicago, Ill. (mail) 2867 E. Grand Blvd., Detroit, Mich.

MILLAR, JOHN HUMPHREY (A) aviation sales engineer, 32 Grosvenor St., London W. 1, England (mail) 148 E. 48th St., New York City.

NAERY, JOHN S. (M) assistant to president, Donaldson Co., Inc., 666 Pelham St., St. Paul, Minn. (mail) 3509 Irving Ave., S., Minneapolis, Minn.

NEPPER, RICHARD CURT (M) engineer, Ahrens-Fox & LeBlond Schacht Truck Co., 800 Evans St., Cincinnati, O.

NORTH, JOHN R. (M) transportation engineer, Commonwealth & Southern Corp., Consumers Power Co., Bldg., Jackson, Mich.

ORSHANSKY, ELIAS JR. (J) vice-president, charge of engineering, Acrotorque Co., 19 Whitney Ave., New Haven, Conn.

OSTERMAN, FRED (A) president, Nelson Chevrolet Sales, Inc., 1002 Diversey Parkway, Chicago, Ill.

ROSEN, CARL G. A. (M) engineer, charge of Diesel development, Caterpillar Tractor Co., 800 Davis St., San Leandro, Calif.

RUBENFELD, ARNOLD (J) chemist, J. H. Rae Oil Co., Inc., Foot of Ambrose St., Rochester, N. Y.

SCOTT, HARVEY, A. (A) supervisor, general buildings, vehicles and supplies, Bell Telephone Co. of Canada 76 Adelaide St., West, Toronto, Ontario, Canada.

SEFFKER, HERMAN C. (M) superintendent, Bee Line, Inc., Nassau St. and Long Island Railroad, Rockville Centre, L. I., N. Y.

SHAY, EDGAR (M) experimental engineer, Chrysler Corp., Oakland Ave., Highland Park, Mich. (mail) 206 E. New Hampshire, Pleasant Ridge, Mich.

SHEA, JOHN W. (A) specialist, field engineering work, National Carbon Co., Inc., 30 E. 42nd St. New York City (mail) 20 Eastchester Road, New Rochelle, N. Y.

SKOWBO, ELMER (A) salesman, Dole Valve Co., 1901-1933 Carroll Ave., Chicago, Ill. (mail) 2-137 General Motors Bldg., Detroit, Mich.

STEIN, LOUIS H. (M) factory superintendent, Aetna Ball Bearing Mfg. Co., 4600 Schubert Ave., Chicago, Ill. (mail) 2019 Fletcher St.

STORCH, HAROLD A. (M) engineer, experimental and development design, Fisher Body Corp., General Motors Bldg., Detroit, Mich. (mail) 843 Whitmore Road, Palmer Park.

TALAY, JOHN J. (J) layout (engines), Central Diesel Engine, General Motors Research, Detroit, Mich. (mail) 182 Margaret West.

VETTER, HAROLD W. (M) chief inspector, Chevrolet Division, General Motors Corp., 6801-17 E. 37th St., Kansas City, Mo (mail) 5951 Paseo.

WETZEL, FRED H. (M) engineer, American Enameled Magnet Wire Co., Port Huron, Mich. (mail) 720 Union St.

WHEILDON, WILLIAM MAXWELL, JR. (J) research engineer, Norton Co., Worcester, Mass. (mail) R.F.D. 2 Framingham, Mass.

WILES, HOWARD M. (M) research engineer, Waukesha Motor Co., Waukesha, Wis. (mail) 527 Grove St.

WIRICK, CAREY G. (A) national sales, Diamond T. Motor Car Co., Chicago, Ill. (mail) 2946 Pine Grove Ave.

ZIURYS, EUGENE J. (J) research engineer, Ethyl Gasoline Corp., 723 E. Milwaukee Ave., Detroit, Mich.

Applications Received

The applications for membership received between June 15, 1937, and July 15, 1937, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

ANTHONY, FELIX M., vice-president and supervising engineer, Super-Power Spark Plug Co., Oakland, Calif.

BARRON, EDWARD T., Carnegie-Illinois Steel Corp, Pittsburgh, Pa.

BRADDOCK, EDWARD, president and general manager, Braddock-Eastlake, Ltd., Windsor, Ont., Canada.

BUMBAUGH, FRANK T., manager, bar and semi-finished division, Metallurgical Department, Carnegie-Illinois Steel Corp., Pittsburgh, Pa.

(Continued on following page)

BURBANK, W. T., draftsman, Fairbanks, Morse & Co., Three Rivers, Mich.

CAMPBELL, MALCOLM GEORGE, president, Kelsey Wheel Co. Ltd., Windsor, Ont., Canada.

CARR, ERNEST H., vice-president, manager, Canadian Plant, Motor Products Corp., Windsor, Ont., Canada.

CARRIGAN, THOMAS, manager, Valvoline Oil Co., Sydney, Australia.

CLARKE, HERBERT E., regional representative, Miller Tool & Mfg. Co., Detroit, Mich.

CRANDALL, BERT H., service manager, Norton Roosa Buick Co., Tulsa, Okla.

DRAPEAU, H. B., thermostat engineer, Dole Valve Co., Chicago, Ill.

DROGE, WILLIAM B., Captain, Motor Transport Officer, Headquarters Trenton CCC District, Trenton, N. J.

DAVIES, JOHN JAMES, chief engineer, Ansett Airways Ltd., Hamilton, Victoria, Australia.

DENTON, CHARLES M., field mechanic, Griffith Co., Arlington, Calif.

DONALDSON, CHARLES, vice-president, Briggs Clarifier Co., Washington, D. C.

DOWTY, GEORGE H., managing director, Aircraft Components Ltd., Cheltenham, England.

DUCKHAM, ALEXANDER, governing director and chairman, A. Duckham & Co. Ltd. and Trinidad Central Oilfields, Ltd., London E. C. 4, England.

FISHER, FRED D., secretary and treasurer, Scientific Brake Service Lab. Inc., Chicago, Ill.

FOX, ALBERT H., research engineer, The Standard Oil Co. (Ind.) Whiting, Ind.

GLOWINSKI, ALBERT D., engineer, Societe des Moteurs Gnome-Rhone, Paris, France.

HICKEY, JOHN H., general service manager, Chrysler Corp. of Canada Ltd., Windsor, Ont., Can.

HIETT, MURTEN G., regional supervising mechanic, U. S. Forest Service, Oakland, Calif.

HILTON, LOUIS MASSEY, Flight Lieut., director, Fairey Aviation Co., Hayes, Middlesex, England.

HUBBARD, JOHN C., assistant transportation superintendent, Kraft-Phenix Cheese Corp., Chicago, Ill.

HUDLASS, MAURICE, consulting engineer, Royal Automobile Club, Pall Mall, London, England.

HURWITZ, MICHAEL, branch manager, Brockway Motor Co. Inc., Washington, D. C.

JONES, J. BYRON, instructor of engineering, Casey Jones School of Aeronautics, Newark, N. J.

KEIM, CHARLES J., design engineer, Oil Well Supply Co., Dallas, Texas.

LINDQUIST, FREDERICK J., junior engineer, Heywood-Wakefield Co., Gardner, Mass.

MACFARLANE, DANIEL ORD, superintendent of production, Commonwealth Aircraft Corp., Melbourne, Victoria, Australia.

MANSFILD, JOHN D., president, Chrysler Corp. of Canada Ltd., Windsor, Ont., Canada.

MARCONI, FRED, owner and operator, Marconi Service Garage, Victoria, British Columbia.

MCLEAN, JOHN ROY, sales manager, Exide Batteries of Canada Ltd., Toronto, Ont., Canada.

MOORE, FRED L., staff engineer, Quality Bakers of America, New York City.

MORGANA, E. FRANK, test engineer, Wright Aeronautical Corp., Paterson, N. J.

NARGIS, MINORU, service manager, Middlesex Sales Inc., Medford, Mass.

OBER, WILLY OTTO, combustion engineer, Gulf Oil Corp., New York City.

PACK, HARRY S., JR., director, Harry S. Pack, Jr., New York City.

PANHANDLE REFINING CO., Wichita Falls, Texas.

PEDLEY, H. A., district operating manager, Socony-Vacuum Oil Co., Inc., Albany, N. Y.

PFOST, LESTER S., tractor engineer, The Massey-Harris Co., Racine, Wis.

RAWLINGS, EVERETT C., mechanical salesman, Standard Oil Co. of California, Spokane, Wash.

REID, LENOX S., sales manager and service, System Brake Service Inc., Newark, N. J.

ROSS, DONALD W., transportation engineer, Geophysical Service Inc., Dallas, Texas.

SCHEDELER, HERMAN HENRY, tool designer, Clark Equipment Co., Berrien Springs, Mich.

SCHOETTLE, JOHN LOUIS, tune up mechanic, Equipment Division of State Road Dept. of Florida, Gainesville, Florida.

SPAULDING, DAVID CHASE, JR., research engineer, Standard Oil Co. (Ohio), Cleveland, O.

SPICACCI, ATTILIO R., assistant chief engineer, New Departure Division, General Motors Corp., Bristol, Conn.

SWAN-FINCH OIL CORP., New York City.

TANGNER, CARL A., service manager, Downtown Chevrolet Co., Tulsa, Okla.

VANDERPLOEG, JACOB SMITH, sales manager, Anaconda American Brass Ltd., New Toronto, Ont., Canada.

WEBER, E. F., superintendent of automotive equipment, Chicago Burlington & Quincy Rail Road Co., Chicago, Ill.

WEST, H. O., superintendent of engineering, United Air Lines Transport Corp., Chicago, Ill.

WINSLOW, JAMES C., draftsman, The Northrop Corp., Inglewood, Calif.

Committee Name Changed

The C.F.R. Aviation Gasoline Detonation Subcommittee has been renamed the C.F.R. Aviation Fuels Committee. The scope of its work has been extended so that it now includes volatility as well as detonation research. Arthur Nutt, vice-president in charge of engineering, Wright Aeronautical Corp., is chairman of the committee.

New Test Engine Will Soon Be in Production

Production will soon start on the new cooperative universal single-cylinder engine designed to permit mounting of full-scale aircraft engine cylinders, to be used in testing and developing aircraft and Diesel fuels and lubricants, spark-plugs, gasoline and Diesel engine cylinders, piston rings and accessories, according to the committee on design of the engine, functioning under the SAE General Research Committee.

A model from the first design of this engine was exhibited at the Summer Meeting at White Sulphur Springs. Since that time the design has been revised three times. The fourth design was discussed at a meeting of the volunteer group on design in New York, July 1. Drawings are now being prepared to incorporate changes approved at that meeting. The Waukesha Motor Co. will build the engine when the final drawings are approved.

To date 12 companies have indicated a desire to purchase the engine. Others interested can obtain more details from C. B. Veal, SAE research manager, 29 West 39th St., New York.

Adverse Weather Lamps

The interim publication of this new specification for motor-vehicle adverse weather lamps adopted by the Society in May is now available from SAE headquarters. The price is 25 cents per copy.

About Authors

(*Continued from page 11*)

● **Merrill C. Horine** *spent his 1907 school vacation working for A. C. Stewart, a pioneer builder of marine engines in Los Angeles, who also dabbled in racing cars and distributed the Dorris Car. That was his first contact with the automotive industry. Continuing in this field he was with the old Stromberg Motor Devices Co. in 1910 and two years later turned to writing as assistant technical editor of "Motor Age," taking editorship of "Commercial Vehicle" in 1913. He was 2nd Lieutenant of Air Service during the War and had the distinction of being the first man assigned full time to motor transport in the Air Service. In 1918 Mr. Horine joined the engineering department of the builders of Mack trucks, being later promoted to his present position of sales promotion manager. He became a member of the SAE in 1917, having held junior membership before that time. He has been active in many phases of the Society ever since and was a vice-president in 1933.*

● **John H. Hunt**, *president of the SAE in 1927, was a college professor before he came into the automobile industry by way of Dayton Engineering Laboratories Co. in 1913. From that research engineering assignment, he was transferred to General Motors Research Laboratories as a section head in 1920. He prepared for electrical engineering at University of Michigan and much of his early automotive work was in the electrical equipment research field. Since 1928 he has been engaged in engineering work in the General Motors Patent Section and has also been director of the G.M. New Devices Section since 1932. He has continued active in many phases of SAE work and, among other things, is at present chairman of the Publication Committee.*

● **Ellis W. Templin's** *experience in truck design and manufacture as well as in fleet operation, doubly qualifies him to comment on operating problems. As automotive engineer with the Los Angeles Department of Water & Power his job is somewhat similar to directing a proving ground. Vehicles in this fleet of 1256 cars and trucks run over all kinds of roads at altitudes varying from 200 ft. below sea level up to 8000 ft. and in temperatures ranging from 26 deg. below zero to 130 above. Since 1914, he has been with the Selden Motor Vehicle Co., where he assisted in building the first Class B Military Truck delivered to the U. S. Army; with the Goodyear Tire & Rubber Co., where he did early development work on six-wheel trucks; with the Six Wheel Co., as chief engineer; with the Chrysler Corp., as supervisor of interplant transportation. He has been an active member of the SAE since 1918, was a Council member in 1928-1929, and chairman of the Philadelphia Section in 1926.*

● **Grover C. Wilson** *and* **R. A. Rose** *last year completed the development of a Diesel indicating apparatus capable of great accuracy at high speeds and of producing a large number of records to compensate for variations in successive cycles of engine operation. After describing the details of this device at the 1936 SAE Summer Meeting, these two Wisconsin professors put it to work in making an exhaustive study of the behavior of high- and low-cetane Diesel fuels. Their paper, in this issue, gives the results. Both men had practical experience with industrial companies before taking up their present work, which Mr. Wilson began in 1920, and Mr. Rose in 1922.*

S. A. E. Papers in Digest

HERE are digests of papers presented at various meetings of the Society.

Some of these papers will be printed in full in the S.A.E. JOURNAL.

Mimeographed copies of *all papers received* will be available, until current supplies are exhausted, at a cost of 25 cents per copy to members; and at 50 cents per copy to non-members, plus 2% sales tax on those delivered in New York City. Orders for mimeographed copies must be accompanied by remittance and should be addressed to Sessions Secretary, Society of Automotive Engineers, 29 West 39th St., New York.

Tractor Meeting

Peoria, Ill. – Apr. 21-23, 1937

Crankcase Ventilation and Sludge – *W. W. Lowther, Donaldson Co., Inc.*

EVER since engines were first built, sludge has been a problem. The elimination of sludge can be accomplished only by keeping the crankcase free from those elements which constitute it, namely, dust, water, acid, dilution, carbon, and mineral particles.

Most engines today are protected adequately by an air cleaner against dust entering the motor through the carburetor. However, a study shows that most engines are not protected adequately against dust and moisture so far as crankcases are concerned. It is the purpose of this paper to bring to the attention of the Society the work which has been done to apply the old principle of crankcase ventilation in a more effective way.

This result is accomplished by taking advantage of the different pressures existing on either side of the throttle, or by taking advantage of the air ram of the intake-air column when the intake valve closes. In this way a flow of clean fresh air can be circulated from the clean-air side of the air cleaner through the closed crankcase. By this method the moisture is drawn off, and the dust excluded.

By eliminating the elements which contaminate oil: dust, water, acid and dilution, we are destined to experience (1) better lubrication, (2) less oil consumption, (3) less frequent oil changes, (4) more trouble-free operation and (5) longer engine life.

Effect of Addition Agents in Lubricating Oil on Piston and Ring Performance in Gasoline and Diesel Engines – *C. M. Larson, supervising engineer, Sinclair Refining Co.*

WITH the increase in horsepower output per cubic inch displacement, gasoline and Diesel engines are more susceptible to ring-sticking and piston-ring or cylinder-liner wear. Formerly crankcase oil stability (how the used oil looked when drained after 50 hr. or more operation in an engine) was considered of prime importance. It was thought that the tendency of mineral oils to cause ring-sticking depended largely on the degree of refinement of the lubricating oil, but this has not proved to be the case with Diesel engines or with high-output gasoline engines.

Highly solvent treated oils have been shown to be deficient in lubricating value, and ring-sticking caused by excessive blowby has resulted. Such high-output gasoline and Diesel engines will operate on straight mineral oils at reduced loads; but reduced cylinder wear, freedom from ring-sticking, and sludge reduction can be had only with proved addition agents. The highly refined paraffinic-base oils plus oiliness addition agents are the most effective for high-output gasoline engines, whereas the naphthenic-base oils plus entirely different addition agents are best suited for Diesel engines.

High-output gasoline and Diesel engine research has shown that a lubricant, to reduce ring and cylinder-liner wear and give freedom from ring-sticking, should consist of a very stable vehicle plus an addition agent which has proper film strength and adhesion, as well as resistance to corrosion and oxidation.

Application of Port Bypass Fuel-Injection Pumps – *H. C. Edwards, Timken Roller Bearing Co.*

THE application of the bypass fuel-injection pump to any engine involves a selection of a plunger size to deliver the proper quantity of fuel with a specific camshaft. The camshaft may be either a constant-velocity or variable-velocity type. When the engine type is known, the fuel-delivery characteristic can be decided upon.

In order to fit the general delivery of the pump over the full range of the engine's operating speed to the maximum amount of fuel which can be used efficiently by the engine, use can be made of the pump delivery valve. Fuel supplied per cycle can be made constant over the full range of speeds, or it can be higher at low speeds than at high speeds or vice versa.

The camshaft has a great deal to do with the fixing of the duration of injection. If a constant-velocity cam is used, the injection rate is determined fairly well, and the delivery valve can be used to control delivery characteristics and pressure surges. If a variable-velocity camshaft is used, a definite type of delivery valve must be used to fix the injection duration at the desired figure.

The use of the delivery valve to control delivery characteristics over a range of speeds or to damp pressure surges, therefore, is somewhat restricted. These observations are made on the basis of fixed-nozzle conditions.

Resistance Welding in the Tractor Industry – *E. A. Mallett, Taylor-Winfield Corp.*

AFTER surveying resistance-welding operations in steel-working industry as a whole, this paper considers applications in the tractor industry where spotwelding, projection-welding, and flashwelding operations are performed on the side rails that form the frame, the wheel tires, steering shafts, starter crankshafts, brake levers, clutch levers, front bolster shafts, front axle shafts, seat supports, seats, fenders, air-cleaner pipes and tops, clutch shafts, brake-drum covers, and transmission covers.

Special spotwelding machines, such as portable spotwelders, series spotwelders, indirect spotwelders, and multiple-acting hydraulically-actuated spotwelders, are discussed. One machine is described that makes 215 spots in 18 sec.

Some Factors Affecting the Design and Performance of Diesel Fuel-Injection Equipment – *J. M. Davies, E. W. Jackson, and G. C. Riegel, Caterpillar Tractor Co.*

ORDINARILY, the fuel-injection equipment is considered as being a relatively delicate part of the Diesel engine. Our experience has shown, however, that under the proper operating conditions, the life of the fuel-injection equipment is as long, or longer, than other wearing parts of the mechanism.

It has been demonstrated clearly to us that the major difficulty with the injection system is almost wholly due to dirt in the fuel. For this reason, this paper was prepared to discuss and disclose our solution of the problem of dirty fuels from three principal viewpoints:

(1) Discussion of the materials, their heat-treatment, and selection, for acceptance in fuel-injection parts, expected to minimize the effects due to dirt.

(2) The design of the injection system to promote easy replacement and service in the field.

(3) The proper handling of fuel for the purpose of eliminating dirt, and the precautions in the design of the engine to help prevent abrasives from entering the injection system.

Servicing of Multicylinder Diesel Engines—*R. J. Kretz, service division, International Harvester Co.*

IT is not the intention of this paper to show in detail all of the problems in connection with the servicing of modern multiple-cylinder automotive Diesel engines. It is planned chiefly to show that it is possible, with correct design and well-organized service departments, to have the service on compression-ignition engines taken care of in the ordinary routine work of already existing service departments. This plan applies to the service departments of manufacturers, distributors, fleet owners, or dealers.

A number of instances of reason for service and service calls are brought out to show that Diesel-engine service, in its last analysis, is really only adding another engine to the line of work already being done. Reference is made to the policy of supplying interchangeable service units, such as injection-pump plunger-and-barrel assemblies.

In an analysis of cost of service the statement is made that labor costs for service on compression-ignition engines are comparable with labor costs on similar-size gasoline engines, and that costs for parts are in proportion to the increase in original cost over the gasoline engine of the same power.

Metropolitan Section Papers

April 6, 1936

Notes on Applying Diesel Engines to Trucks – *B. B. Bachman, The Autocar Co.*

PRELIMINARY results of a program of road tests on one gasoline and two Diesel trucks are reported in this paper. Objectives of the program described were to determine the design factors that would be affected by the use of a Diesel engine, and to learn how such an engine would behave from the standpoints of power, fuel consumption, lubrication, and life.

Two Diesel units were employed – one with an old engine and one with a new one – each mounted on a tractor hauling a semi-trailer at about 40,000 lb. gross vehicle weight. These vehicles were compared with an equivalent gasoline unit.

General conclusions drawn included the following:

Diesel equipment will weigh more and cost more than gasoline equipment for a given service. Fuel consumption can be expected to be 50 per cent less than that of a gasoline engine. The total saving in fuel costs will depend upon many other factors which render it impossible to make an intelligent general statement.

Emphasis is placed on the preliminary nature of the conclusions, and that no definite statements could be made on maintenance costs until considerably more service experience had been recorded.

Elementary Theory of the Diesel Engine – *C. C. Hinkley, executive engineer, Buda Co.*

THE difference between the air-injection type developed by Dr. Diesel and the solid-injection type patented by Akroyd Stuart is pointed out in this paper, as is the difference in combustion characteristics or cycles of these two types of compression-ignition engine. The necessity for ignition delay in Diesel engines is explained, and why it must be allowed for.

Lines of thought in Diesel combustion, as manifested in combustion-chamber design, are classified under three headings: open-chamber, quiescent type; open-chamber, turbulent type; and precombustion-chamber, quiescent type, with the manufacturers that are now producing each kind. Air-cell type of turbulent-controlled combustion and the Lanova system also are discussed.

The author ventures predictions as to future applications of Diesel engines in the automotive field. Figures are quoted to show how far behind other countries we are in the use of Diesel engines, with some explanation for our delinquency.

Diesel Engines in Transportation – *Morris R. Lerner, Newark College of Engineering.*

THIS paper traces the history of the Diesel engine both in the United States and Europe.

The subjects treated are the general characteristics of automotive Diesels and some of the major problems of their design and operation, including torque characteristics, exhaust gases, noise, and vibration. The latest and most efficient type of combustion-chamber also is discussed in relation to the smoothness of operation.

A comprehensive comparison of operating costs between Diesel and gasoline automotive engines is made, including both the inherent economies of the engines and the engine performances in similar service.

Alcohol Blends in Gasoline – *Helmut Schelp, Stevens Institute of Technology.*

THIS paper contributes to the solution of the problem of whether alcohol is a suitable means for increasing the antiknock quality of fuels.

Four kinds of alcohol were used in tests by the C.F.R. motor method: butyl alcohol, ethyl alcohol, methyl alcohol, and isopropyl alcohol, mixed in different percentages with standard reference fuel A-4, to show the efficacy of each alcohol blending agent.

Mixing the alcohol with the gasoline in the carburetor instead of in the tank is suggested as a means for making alcohol blends of aviation gasolines suitable for aircraft use. Also it is pointed out that, by means of adjusting such a carburetor, it would not be necessary to use two different gasolines for take-off and normal cruising.

Cleveland Section Paper

April 13, 1936

Application of Your College Training to Engineering – *Ferdinand Jehle, director of laboratories, Hoffman Specialties Co.*

IN this paper an engineer is defined as a person who is well grounded in the fundamental sciences and their application to the design and operation of machinery, structures, and processes. Engineering students are counseled to become this "old-fashioned" type of engineer and to master the art of being managed before venturing into management.

The importance of detail work, public speaking, and technical writing is stressed. Reading technical literature and joining the proper engineering society are recommended as the best ways to progress along technical lines.

To show the application of college courses to engineering, the remainder of the paper is devoted to a comprehensive discussion of tests on engines and their component parts as conducted at the research laboratories of a large truck manufacturer.

New England Section Paper

April 14, 1936

Motor Vehicle Operation and Maintenance – *Capt. J. M. Matson, in charge of operation at Army Base, C.C.C. Motor Repair Shop, Army Base, Boston, Mass.*

THIS paper is recommended for consideration as an informative statement of facts and exposition of the plan of maintenance now existing in this Corps Area. It explains the present policy and gives a prospectus of the future plans and provisions to be made for the maintenance of transportation.

At no time during the past fifteen years has so much thought and intensive study been given to motorization in the Army, including the National Guard. Undoubtedly the Army as a whole is more motor-conscious than at any time since the World War.

Motor transportation as organized in our service is divided into three parts: operation, maintenance, and inspection.

No. California Section Paper

April 14, 1936

Engineering Problems in Trans-Oceanic Flying – *John C. Leslie, division engineer, Pan American Airways System.*

DISCUSSION in this paper centers around fundamental flight problems, of which that of getting the maximum number of ton-miles of payload out of a gallon of gasoline is given primary consideration.

The effects of such variables as speed, gross weight, and altitude on horsepower output and specific fuel consumption are explained, and the necessity for finding those conditions where the summation of all variables gives the most favorable results so that the pilot is able to use this information practically and easily under all conditions. The paper describes the operation of automatic mixture control and constant-speed propellers and how they improve engine performance. Problems of air-cooling and cabin and cockpit heating also are considered.

Statements are backed by facts and figures taken from trans-oceanic flights.

Philadelphia Section Paper

April 17, 1936

Sheet Steel in Present Car Design – *W. R. Shimer, metallurgical engineer, Bethlehem Steel Co.*

CONTRASTING modern automobile steel sheets with their special finishes, deep-drawing qualities, increased widths, and lighter gages with the sheets of 25 years ago, this paper shows how these exacting requirements have reduced the margin of safety as to whether or not a sheet will make a satisfactory part.

The care during all stages of manufacture that must be exercised to meet these specifications is pointed out, and the necessary equipment and new processes are enumerated. The need for hitting the happy medium of temper and for using the sheets very soon after manufacture is stressed.

A plea in behalf of the steel makers for more advance information on new models concludes the paper.

Northwest Section Paper

April 24, 1936

Buses for Mass Transportation – *Murray Aitken, Kenworth Motor Truck Corp.*

THE public transportation system of a city must compete in comfort, speed, and convenience with a man's own automobile, and yet be much more economical.

In this paper the advantages of buses in the mass-transportation system, such as low first cost, lightness, speed, and flexibility, are pointed out.

The bus with the engine over in front of the flywheel is seen as giving way to buses with their powerplants in the rear or under within the wheelbase, for reasons of better weight distribution, lower floor height, better noise insulation, and improved riding qualities. One important advantage cited for the rear-engine location is the possibility of having an entrance door ahead of the front axle, permitting the driver to approach the curb so that the passengers may step directly into the bus from the

(*Continued on page 36*)

What

Foreign Technical Writers Are Saying

AIRCRAFT

Monocoque Construction

By I. J. Gerard. Published in *The Journal of The Royal Aeronautical Society,* June, 1937, p. 467. [A-1]

The author points out that owing to the limitations of available materials, a more practical construction than the pure monocoque for all but comparatively small aircraft, is a hybrid construction comprising skin reinforced by internal stiffeners capable of taking compressive loads. This type of construction is sometimes called semi-monocoque construction, and for light spread-out structures it is in many cases more efficient than the pure monocoque construction on a strength/weight basis, as the design utilizes both the efficiency of the skin in taking tensile loads and the efficiency of the stiffeners in taking compressive loads. The skin in turn may also be utilized to support the stiffeners in such a way as to enhance their capacity for carrying compressive loads.

It appears, therefore, that the design of a light and efficient semi-monocoque construction requires minimum practical thickness of skin, reinforced by internal stiffeners against collapse by waving or buckling due to compressive and/or shear loads. The design of the stiffeners covers a wide field of types and is analogous to the design of spars and struts. There already exists a useful accumulation of data making it possible to design efficient tension joints in thin sheet and also efficient struts and spars; and data on which to estimate what compressive or shear loads a thin sheet panel of any given dimensions may be expected to carry. It remains to choose the best combination of sheet and stiffener for any given loading.

To illustrate a method of approach to this problem the author describes a simplified example in connection with the design of a fuselage. For present purposes it is assumed that the fuselage is a tapered circular or elliptical sectioned tube restrained at the front end by inertia or other loads and subject to vertical and horizontal lateral offset loads due to aerodynamic loading of the tail. The example is simplified still further by representing to some extent this fuselage by a circular sectioned cylinder and determining its strength: (a) in pure bending, (b) in pure torsion, and (c) in combined bending and torsion. The data obtained from the simplified example may then be utilized in estimating the strength of an actual fuselage. This simplified example of monocoque construction is relatively cheap to construct and to test, and cylinders of this type have been included in a program of tests at present being conducted by the British Air Ministry. The methods and results are discussed in this paper.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

Aeroplane Stability and the Automatic Pilot

By F. W. Meredith and P. A. Cooke. Published in *The Journal of The Royal Aeronautical Society,* June, 1937, p. 415. [A-3]

Automatic pilots are gradually coming into general use all over the world, the authors point out, adding that their usefulness has now been proved over a period of about ten years in Great Britain and over a somewhat shorter period in other countries.

While not attempting to go thoroughly into the mathematical theory of the stability of a mechanically controlled airplane, the authors survey broadly the concepts with which the mathematical theory deals and consider the merits and demerits of the diverse systems which have been developed for meeting the problem.

At High Altitude

By F. W. Lanchester. Published in *The Journal of the Royal Aeronautical Society*, May, 1937, p. 388, and June, 1937, p. 437. [A-4]

The author demonstrates that under certain conditions variations in the Reynolds number as due to altitude are unimportant. The first part of the paper deals with the nature of the problem, the question of Reynolds Number, body resistance, altitude as affecting the velocity of sound, etc. In Part II the engine, and more broadly the power plant, is considered in its relation to altitude. The discussion hinges mainly on the question of supercharge. The difficulties connected with supercharge as affecting temperature, having been made clear, the subject of inter-cooling between compressor and engine is dealt with at length with the aid of thermodynamic diagrams. The propeller is discussed, and the case for variable pitch made clear. The paper also discusses the subject of surface cooling applied both to the engine and to the inter-cooler.

ENGINES

Flame Travel in an Internal Combustion Engine

By S. S. Watts and B. J. Lloyd-Evans. Published in *Engineering*, June 25, 1937, p. 713. [E-1]

Reference is made to recent reports on this subject and to a paper read in 1934 by the present authors in which they discussed the temperatures in a gasoline engine and pointed out that they had found evidence of the continuation of flame during a considerable fraction of the firing stroke. Tongues of flame were visible over some 90 deg. of crank angle after the top dead center, and the values of $\frac{PV}{T}$ increased over the same range of crank-angle where P is the average pressure, V the volume behind the piston and T the absolute temperature at a definite point in the engine cylinder. This probably indicated that chemical combination was not completed.

The tests described in this paper were made on a four-stroke gas engine of 4¼ in. bore and 6 in. stroke, at 496 r.p.m. and 585 r.p.m. This engine was particularly suitable for these tests as it had an open trunk through which the electrical connections to the piston could be carried; also the charge in a gas engine is of more uniform composition and more regularly distributed than is the case with engines using liquid fuel.

It is the hope of the authors that they can arrange to carry out similar tests on a gasoline engine to ascertain whether the maximum flame speed is again obtained with a mixture about 18 per cent rich. It is pointed out that the tests measure the time at which flame reaches a given point in the cylinder, but this does not necessarily mean that combustion is complete behind the flame front.

The Art of Dynamometry

By N. S. Muir. Published in *Aircraft Engineering* May, 1937, p. 126, and June, 1937, p. 149. [E-1]

This paper, dealing particularly with the measurement of engine power in flight, is divided into three parts: Historical review, variation of engine power with height, and description of a new transmission dynamometer developed primarily for the measurement of engine power in flight.

This dynamometer was the outcome of a decision reached by the British Air Ministry in 1930 that work should proceed aiming at the evolution of a satisfactory transmission dynamometer for the measurement of engine power in flight and the wind tunnel. At a conference held at the Royal Aircraft Establishment on March 19th, 1930, to consider certain design suggestions put forward, the line of attack chosen for the research was the construction of a torquemeter in which the angular deflection of a spring element inserted in the drive between an engine and airscrew would be measured by electrical means using variable air-gaps. The basic design for the first torquemeter was put in hand after the conference and was completed about the end of October, 1930. The apparatus was ready for a preliminary static calibration on May 1, 1931. Development work and bench testing have resulted in the present redesign, which is described in detail in the article together with the results of tests.

Fuel Pumps for Aeroplanes

By W. C. Clothier. Published in the *Journal of the Institution of Automobile Engineers*, May, 1937, p. 12. [E-3]

The author considers the conditions under which an airplane fuel pump has to work and discusses the various typical pumps which have been developed specially for use in airplanes.

In defining the conditions under which the pump works, Mr. Clothier considers briefly the conditions imposed by the fuel system, pointing out that the effective head with which the pump has to cope is the sum of the heads due to gravity, acceleration, pipe friction, and the pressure required by the carburetor. These are dealt with in some detail.

Under general requirements of the pump the author discusses delivery pressure to the carburetor, position of the pump, source of power to drive the pump, capacity of the pump, pressure control and other detail requirements.

In the discussion of pump types three classifications are given: centrifugal, displacement with valves, and displacement of the interference type which are usually valveless. The early

designs are reviewed briefly under those headings. Typical modern fuel pumps which are said to be all of the displacement type, are classified as diaphragm pumps, piston pumps, vane pumps, and gear pumps. Among the pumps described are Amal, Armstrong Siddeley, DeHavilland, Pobjoy Tecalemit, Korect Depth Gauge Co. pumps, Hobson, A.M., Bristol, Evans, Romec, Napier Gear, and Rolls-Royce.

The Diesel Engine

The Automobile Engineer, June, 1937. Special Diesel Issue. [E-3]

The editorial comment introducing the annual Diesel issue points out that while there have been no epoch-making developments during the year the normal evolutionary process has continued without any particular setback. Technical advance in design and manufacturing detail contimue but the chief problem before the industry is still that of high first cost with operating economy, largely on account of the fuel tax, still a factor. A trend away from the turbulence chamber and air-cell types in favor of direct injection is noted, not only because of fuel economy but also the startability. A slight fall in the registration of commercial vehicles but an increase in the larger passenger-carrying vehicles is indicated.

Cylinder Bore Wear

By Alex Taub. Published in *The Automobile Engineer*, April, 1937, p. 134. [E-4]

Mr. Taub, impressed with the prevalence in Europe of excessive bore wear, a problem which no longer exists in the United States, discusses the subject in this paper presented to the Engineering Society of City and Guilds College, South Kensington.

The author contends that bore wear is a resultant of incomplete design to meet various conditions of operation.

The normal approach is through four main channels, sufficient oil, adequate blow-by and oil control at the piston rings, crankcase ventilation sufficient to create a depression of one-half inch of water and thermostatic control for the quickest warm up.

He points out that for each of these elements there is much detail to be considered.

The paper compares European and American results, discusses contamination, bore lubrication, piston rings, and erosion.

MATERIAL

Copper and its Alloys in Automobile Design

By D. P. C. Neave. Published in the *Journal of the Institution of Automobile Engineers*, June-July, 1937, p. 11. [G-3]

Parts I and II, Uses of Copper and Brass in Wrought Forms and Bronzes Used for Bearings, Etc., the author points out, are intended to be a brief commentary on present average practice with regard to copper and its alloys in automobile design, and an effort has been made to arrange the information in narrative order, while including references to specifications.

The latter half of the paper is a progress report on certain comparatively new uses of copper, some of which are still in the development stage. This part includes: Copper Alloy Cylinder Heads; and Copper Alloy Cast Irons, Malleable Irons, Cast and Wrought Steels.

La Fabrication de Combustibles Liquides par Traitement des Combustibles Solides par des Solvants

By Charles Berthelot. Published in *Le Génie Civil*, March 20, 1937, p. 266. [G-5]

The Pott and Broche process for use in connection with the production of liquid from solid fuels, developed in Germany by the Stinnes group, will find its first practical application this year in a plant to be opened in that country.

The process consists essentially of submitting coal to the action of solvents, which results in the formation of two sets of substances, one having molecular weights of less than 2,500, or one-fourth that of coal, and of one consisting of those constituents of coal which are not readily hydrogenated. The process is carried out in stages of successively higher pressure and temperature. While exact knowledge concerning the characteristics of the product of the process is not available, it is thought that the extract, which is solid and black, resembling tar, will be suitable, after solution in coal oil, for Diesel engines, with the exception of the high-speed type. However, the object of the process is not so much the production of a substance immediately usable, as the production of an oil much more easily hydrogenated than coal itself. It is thought that hydrogenation in both the liquid and vapor phases will be necessary.

The operation of the new plant will be watched with much interest, as it will demonstrate the practical significance of the new process.

PASSENGER CAR

Racing Motor Car Design

By R. A. Railton. Published in *The Automobile Engineer*, May, 1937, p. 171. [L-1]

The author while disclaiming the title of "Expert on racing car design" makes it clear that, so far as modern racing cars are concerned, he can claim to be an expert observer only, but of world record cars he can speak with more confidence, having been engaged in their design and manufacture for the past six years. The paper is confined to an account of some of the special problems involved in making a motor car travel fast and to the methods adopted

to meet those problems. Springing, independent suspension, chassis, tires, weight distribution, steering, brakes front wheel drive, transmission, engine, supercharging, and fuels are the subdivisions under which the subject is discussed.

Der Kurvenlegerwagen

By Joachim Kolbe. Published in *Automobiltechnische Zeitschrift,* March 25, 1937, p. 146. [L-1]

The object of the author's three years research was to develop a passengar-car in which, in negotiating curves, the entire body would be inclined toward the inside of the curve, so that passengers would not feel the effects of centrifugal force as in the conventional construction.

The author presents tables showing the degree of inclination needed for various curve radii and car speeds, the amount of time needed to negotiate a curve at various body inclinations and car speeds, and the relation between curve radii and permissible car speed. He describes a few trial designs in which the body was flexibly suspended over its center of gravity, and details the reasons for their rejection. In the final design, the body is supported over the axles by four brackets, one at each corner of the body. These brackets are so jointed at the axles as to permit the body to be inclined in traversing curves, and to remain vertical when the axles are inclined in traveling over uneven terrain. In these displacements, the center of gravity of the body is lowered. Springs are provided to bring the body back to its original position, after the need for the displacement has passed.

The author claims for his design greater riding comfort, greater security against tipping and skidding, quieter construction, less wear and tear on both passengers and material, and higher permissible speeds. Production costs are estimated as about equal to the conventional construction, since saving will be possible in the less-stressed body and frame to make up for the extra parts required.

The Berlin Automobile Show

Published in *The Automobile Engineer,* April, 1937, p. 115 and May, 1937, p. 155. [L-3]

Part I gives a survey of the trend in private car design; part II, a review of the commercial vehicle section.

Part I of this article states that in the opening ceremony of the 1937 German International Automobile Exhibition, held from February 20th to March 7th in Berlin, speeches by Herr Hitler and Dr. Goebbels, emphasized the need for a low-priced car for the people.

The comments indicate that a very high standard of design appeared to be maintained throughout the Exhibition, which was confined very largely to the products of Central Europe. But apart from minor detail, very little novelty was to be observed, particularly in the section devoted to private cars, while the number of entirely new chassis exhibited could be counted on the fingers of one hand. However, this was attributed not to a lack of initiative on the part of German designers but rather a sound production policy, i.e., concentration on continuous production and stabilization of the rather striking novel designs and pioneer layouts shown two years ago. Recent road construction has influenced design, the article points out. The outstanding models are described.

L'Industrie Automobile Française. "Conseil National Economique"

Published in Journal de la *Société des Ingénieurs de l'Automobile,* February, 1937, p. 79. [L-3]

French automobiles, as compared with those of other countries, particularly the United States, do not show to advantage in several particulars. Because of small quantity and diversified production, neither the raw material or the production machines are so good, and the taxation policy which has penalized power has led to a type of vehicle not suitable for the widest current market. The present French product is characterized by an extremely high-speed engine and an exaggerated lightness of chassis, hence lacking in both durability and flexibility. France should look for her automotive market to her rural districts and her colonies, and should provide for this market a simple, robust, easily maintained car, adaptable to difficult terrain and with an important power reserve.

This frank analysis of faults and proposal for amendment are part of a report on the French automobile industry, presented at the National Economic Conference. The latter body made the following recommendations:

1. All French and foreign manufacturers established in France should found a central laboratory for automotive and fuel research, sharing in the expense and in the results obtained.

2. The French automotive industry should organize with the object of reducing the number of models, standardizing raw materials, pooling purchases and reserving to certain specializing companies the manufacture of parts for which they are specifically equipped.

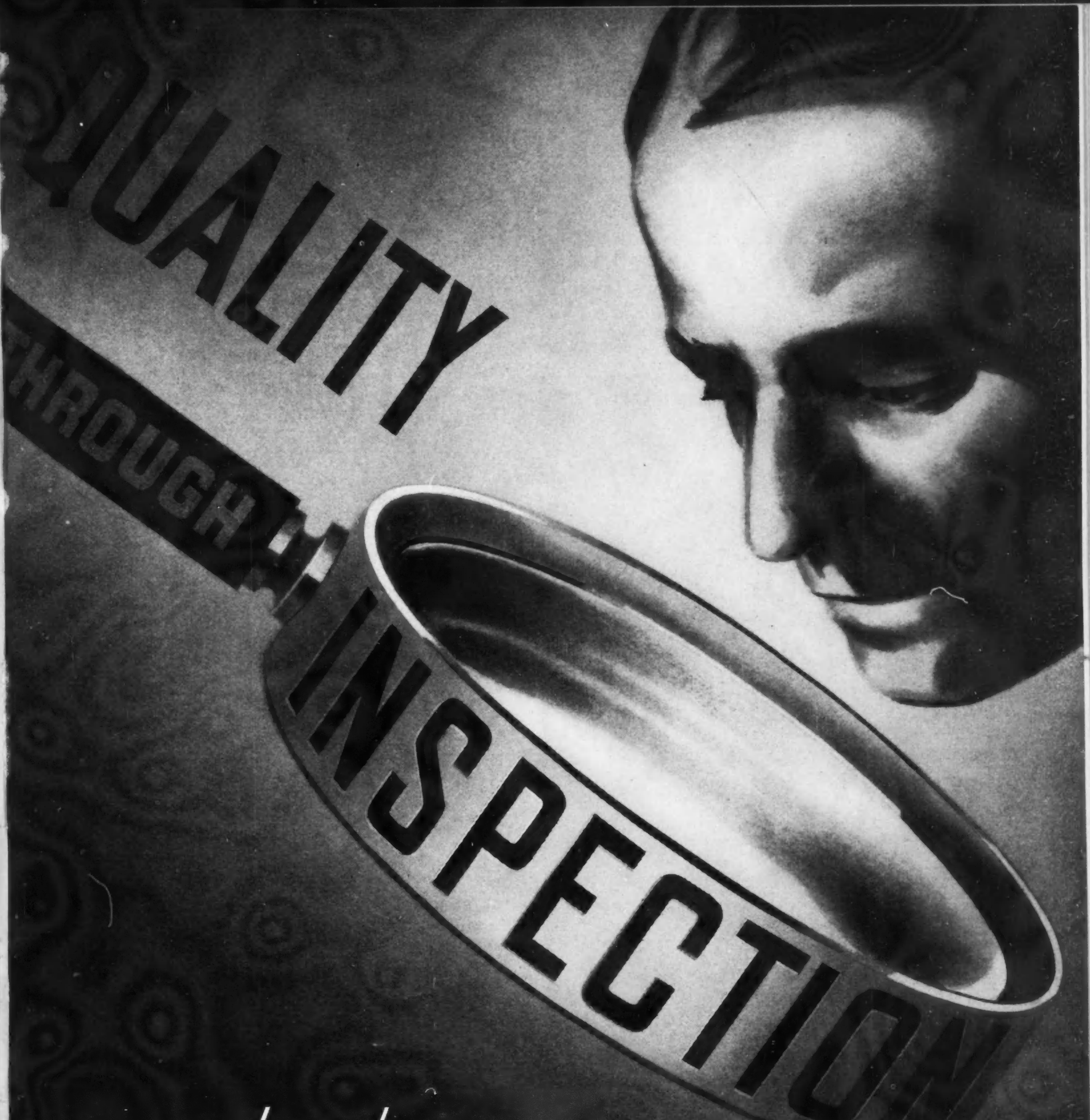
3. Quantity production should be devoted to a simple, robust, cheap vehicle.

4. A central statistical bureau should be established, which should charge itself with the study of foreign markets for French products.

5. The sale of new cars should be assisted by official valuation of used cars.

6. The use of cars by the laboring classes should be encouraged by the construction of garages of moderate rental.

The report presented covered production, sales, operation, unfavorable conditions in the industry, and unfavorable phases of public policy, particularly road construction, traffic control, safety regulation and taxation.



HARRISON

Inspection plays an important role in the manufacture of Harrison radiators. Raw materials must conform to rigid specifications. Jigs, fixtures and dies must check accurately with drawing limits. Each component part must measure up to the Harrison standard—and, finally, every radiator must pass an over-all inspection before it is approved for shipment.

Trained men, long experienced in Harrison service, are constantly on the alert to maintain the high standards that safeguard Harrison quality.

HARRISON RADIATOR DIVISION, General Motors Corp., Lockport, N.Y.

RADIATORS · THERMOSTATS · CAR HEATERS · HEAT EXCHANGERS

SAE Papers in Digest

(*Continued from page 30*)

curb. With the rear-engine bus it is claimed that maintenance and inspection are simplified because of the improved accessibility of the powerplant and accessories.

No. California Section Paper

May 12, 1936

Midget Racing – ***Joe Banzi, president and business manager, Northern California Midget Association.***

THE growth of midget racing is reviewed in this paper from the first midget race in June, 1932, at Sacramento, Calif., to the formation of the Northern California Midget Association early in 1936. In this year midget racing became a national and international sport with meets held in Seattle, New York, Florida, Los Angeles, Chicago, and other cities.

Specifications drawn up by the Northern California Racing Association for midget racing cars with four-cycle and two-cycle motors are presented, along with a general discussion of the development of midget-car construction and of the wide variety of powerplants in use today ranging from the ordinary motorcycle engine to the Offenhauser, some with aluminum blocks and dry steel sleeves.

Philadelphia Section Paper

May 13, 1936

Reclamation of Automotive Parts – ***A. B. Gordon, The Linde Air Products Co.***

FOUR welding methods for reclaiming automotive parts using the oxy-acetylene process are discussed in this paper:

(1) Bronze-welding – using bronze welding rod for joining parts of higher melting point than the bronze rod.

(2) Bronze-surfacing – essentially the building up of bronze weld metal on parts by bronze-welding.

(3) Fusion-welding – welding parts with rod of composition similar to the base metal, involving also melting of the base metal.

(4) Hard-facing – the welding of special alloys to the surfaces or edges of parts requiring special protection against wear.

The choice of the correct method to reclaim various worn or broken parts is explained, and specific examples are cited of the savings in money and time that have been effected by these methods.

So. California Section Paper

May 21, 1936

The Development of Superchargers and High-Compression Engines – ***Floyd F. Kishline, chief engineer, Graham-Paige Motors Corp.***

BELIEF in the desirability of increased compression ratios with higher octane-number fuels based on the opportunities thus afforded for engine development, in many respects other than maximum power per cubic inch of piston displacement although some increase in maximum power usually is attendant, is backed by a review of the increasing efficiency and fuel economies of racing automobiles using elevated compression ratios and higher antiknock fuels.

The author attempts to dispel the false impression of supercharging given by its prefix "super" as an overdose of mixture rammed into the cylinders regardless of consequences other than more power – and suggests the term "positive induction" as more appropriate.

Performance data, characteristics, and construction details of moderate- or low-pressure supercharged or "positive-induction" engines comprise the body of the paper.

Northwest Section Papers

Sept. 11, 1936

Application of Small Diesel Engines in the Navy – ***Lieut. S. R. Bedford, engineering officer, U.S.S. Cushing.***

THIS paper describes the Navy's efforts to solve the problems of fire hazard, economy, and reliability in the operation of small motorboats through the adoption of Diesel engines. It outlines the program for trying out 158 of these engines of 25 hp., 60 hp., and 105 hp., and of four- and six-cylinder, four-cycle, high-speed, geared types. If successful, the author states that these engines will replace gasoline engines in about 1800 Navy boats.

Restrictions placed on these engines are pointed out, such as fire haz-

(*Continued on page 38*)

SAE Papers in Digest

Continued

ards, salt-water cooling, constant exposure to all kinds of weather, intermittent service, and cold-starting. Design, construction, and operating details are reviewed to show how well they meet requirements.

Naval Aircraft Engines – *Lieut. V. H. Soucek, naval aviator, U.S.S. Ranger.*

THE bulk of Naval aircraft engines are of the nine-cylinder and fourteen-cylinder radial air-cooled type. Training planes use nine-cylinder engines of 300 hp., normally aspirated. For medium-size planes, such as small fighters or observation scouts, nine-cylinder engines are employed that develop 450 hp. normally aspirated, or 600 hp. when supercharged. Two types are used for heavy seaplanes, large fighters, or utility planes: either nine-cylinder, single-row engines of 1820 cu. in. displacement and varying power depending on the compression ratio and the degree of supercharge with an average of 800 hp., or two-row, fourteen-cylinder engines with a displacement of 1830 cu. in. and an average of 800 hp.

The remainder of this paper discusses trends in Naval aircraft engines, maintenance and inspection procedure, fuels, and lubricants, frequently comparing the airplane engine with that of the automobile.

No. California Section Paper

Sept. 15, 1936

The American Picture – Diesel Fuel Research – *C. G. A. Rosen, Caterpillar Tractor Co.*

PRIMARILY intended as a discussion and amplification of the paper of Messrs. Boerlage and Broeze presented at a meeting of the American Chemical Society, April, 1936, this paper is limited to a discussion of the fuel research conducted at the San Leandro laboratory of the Caterpillar Tractor Co. and, therefore, to the precombustion-chamber type of Diesel engine burning California-base fuels.

After explaining the principle of operation and construction of the precombustion type of Diesel engine, the paper describes investigations of ignition quality, fuel-spray characteristics, and injection phenomena by means of a single-cylinder test unit fitted with a quartz observation window, stroboscope, timing disc and phase-changing device.

Spray patterns are discussed for different fuels. Flame duration is measured within the main combustion-chamber for two types of spray valves, and flame duration and fuel consumption are compared at two jacket-water temperatures. Other factors studied are the influence of jacket-water temperature on the envelope surrounding the combustion-chamber, and the influence of fuel viscosity, ignition quality, and volatility on flame duration and fuel consumption, as well as the influence of boiling range or fuel volatility on performance as related to speed.

A discussion of the products of incomplete combustion as influenced by compounded lubricants and ring-belt temperatures concludes the paper.

Chicago Section Paper

Oct. 6, 1936

Operating the Modern Vehicle with Air Brakes and Air Control – *S. Johnson, Jr., chief engineer, Bendix-Westinghouse Automatic Air Brake Co.*

AFTER emphasizing the importance of effective brake control as available in air brakes, this paper reviews developments of the last few years in the automotive air-brake system directed toward improved operation and reduced maintenance.

Compressors, relay valves, relay-emergency valves, automatic emergency equipment, slack adjusters, and brake rigging are among the parts discussed.

Success of the flat-rate system of maintenance repair established two years ago is attributed to the fact that it makes a quick and economical interchange of units when repairs are necessary.

No. California Section Papers

Oct. 13, 1936

Physiological Conditions in Driving Safely – *Dr. Eric Ogden, assistant professor of physiology, University of California.*

IN this paper safety is studied from the standpoint of the driver, and the claim is made that, from his angle, most accidents are due directly either to error or to delay in judgment.

(*Continued on page* 40)

SAE Papers in Digest

Continued

The influence of well-formed driving habits on safe driving is discussed, as is the reflex mechanism by which we learn habits.

Conditions that impair the working of the brain, delay judgment, and introduce errors are classified into four groups. The first comprises fatigue, hunger, vibration, and wrong eating. The second is the circulation in the blood of chemical poisons such as carbon monoxide and alcohol. In the third are such physical disabilities as may impair the appreciation of a new situation or the execution of a reaction appropriate to it. And finally there is mental inadequacy which may be simply a poor intellect or the results of a mental disease.

The remainder of the paper is devoted to a discussion of these conditions and how they may be avoided or mitigated.

Can We Build Automobiles to Keep Drivers Out of Trouble? – *Victor W. Killick, chief, Bureau of Statistics, Department of Motor Vehicles, Sacramento, Calif.*

CLAIMING that not more than 5 per cent of the country's population ever will become expert drivers, this paper turns, for the solution of the safety problem, to a "self-protecting" car – one that will limit more effectively the number of possible mistakes that the driver can make.

Design changes recommended for such a "fool-proof" car, include "tear-drop" design with the motor in the back as giving better vision, more space, and a tendency to bound away when it strikes something. The importance of the position of the center of gravity on braking, stability, and steering is stressed. Speed control and governing top speeds are discussed fully.

In conclusion the author predicts radical changes in automobile design in the next five years that will result in such a "fool-proof" car.

Washington Section Paper

Oct. 13, 1936

Designing and Building for the Commercial Aircraft Market – *Col. John H. Jouett, president, Fairchild Aircraft Corp.*

IN this paper a non-technical and brief presentation is made of the woes and trials with which the manufacturer of private airplanes is faced.

Recalling the emphasis placed on the military phase in the early development of aviation, the more difficult problems of the private airplane manufacturer are pointed out. For example, requirements for military planes are dictated by a relatively few tacticians as compared with the thousands of private buyers with divergent ideas and needs that have to be crystallized. Also, aircraft manufacturers for the private-owner market have to gamble more than those making military planes who are assured of adequate recompense from the Government. Eleven important considerations of the commercial manufacturer are listed.

Pittsburgh Section Paper

Oct. 20, 1936

Development of Air Transport – *R. F. Crawford, vice president, Pennsylvania Airlines and Transport Co.*

A BRIEF but graphic portrayal of the last decade in air transport is presented in this paper.

The author contrasts his company's 90-hp. plane carrying 3 lb. of mail and flying without regular weather reports in 1927 with today's aircraft, expert weather service, modern instruments, and radio beams. These facilities are discussed, along with inspection and scheduling procedure.

Problems not overcome are stated as fog, ice on the wings, and water in the gasoline; their present and proposed solutions are outlined.

Regional T & M Meeting Newark, N. J.

Nov. 5, 1936

Some Recent Observations on American and European High-Speed Diesels – *A. J. Blackwood, Standard Oil Development Co.*

THIS paper indicates that almost equal strides are being made in Diesel-engine development in this country as compared with Europe even though conditions in Europe generally are more favorable to Diesels, primarily because of higher fuel costs.

(Continued on page 42)

Not one failure in 5 years

WITH CHROMIUM-VANADIUM SPRINGS ON NEW YORK CITY'S INDEPENDENT SUBWAY SYSTEM

During 1936, New York's city-owned and operated subway established some remarkable records. For example, 262,000,000 passengers were handled with an "on time" record of 99.78% in the 1300 cars which were furnished by American Car & Foundry Company, The Pullman-Standard Manufacturing Company, and Pressed Steel Car Company, Inc.

The Chromium-Vanadium springs produced by Pittsburgh Spring and Steel Co. which are used exclusively on these cars made a record for themselves, not during 1936 alone, but since 1931 when they were first applied. During this five-year period there has not been a single failure of Chromium-Vanadium springs.

In passenger cars, buses, and trucks. . . . in heavy mobile equipment of every type . . . Chromium-Vanadium Steel Springs with their higher physical properties . . . not only insure longer service life but also provide greater riding comfort.

Metallurgists of the Vanadium Corporation of America will be glad to help you with your spring problems. No obligation, of course.

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of vanadium, silicon, chromium, and titanium, produced by the Vanadium Corporation of America, are used by steel makers in the production of high-quality steels.

FOR STRENGTH · TOUGHNESS · DURABILITY

SAE Papers in Digest

Continued

In July, 1936, Diesel-powered vehicles numbered 32,800, and one bus company in England operates 1200 of them. In a comprehensive discussion of Diesel operation in Germany, England, and Italy, direct-injection and precombustion types, fuels, speeds, and starting difficulties are covered.

Overloading is given as the cause of the smoky exhaust experienced in Diesel operation in California. The paper also reports that, in Europe, ring-sticking is avoided largely by more frequent cleaning, and that maintenance costs are generally lower or equal to those of gasoline engines.

Indiana Section Paper

Nov. 5, 1936

Thermo-Setting Molding Practice – *W. B. Hoey, Bakelite Corp.*

As defined in this paper, thermo-setting materials are dry granulated powders ready for molding containing synthetic resin binders which react chemically under the heat and pressure of the molding process. Usually the dry powder is preformed cold into tablets, pellets, pills, or preforms for convenient handling. When in the steel molds, heat and pressure of 290 to 350 deg. fahr. and 2000 to 5000 lb. per sq. in., respectively, are applied, and the material fluxes and flows into the various crevices of the mold cavity. After a short time the mass polymerizes and is hard when ejected from the mold.

Two distinct types are discussed: the phenol-formaldehyde compounds, known by such trade names as Resinox, Indur, Durez, Makalot, and Bakelite, and the urea-formaldehyde compounds, with names such as Beetle, Plaskon, and Unyte.

In considerable space devoted to the design of molded parts, the point is stressed that there are hundreds of formulas for plastic materials and that engineers and production men should consult experts when planning a new application to find out the material that is best adapted to the use in mind.

Possibilities of future applications are sketched and present limitations defined. But sudden changes must be expected because of the rapid development of the industry, the author warns.

No. California Section Papers

Dec. 8, 1936

Lubrication Trend in 1937 Car Design – *G. L. Neely, Standard Oil Co. of Calif.*

The profound influence that passenger-car design trends have upon their lubrication trends is stressed. Thus, since 1937 passenger-car trends show no radical changes but many refinements, the author concludes that the year 1937, with a few exceptions, will be rather barren as far as indicating the lubrication trend is concerned.

Lubrication is discussed under headings of engine design, oil filters, crankcase ventilators, plated pistons, crankcase temperatures, oil distribution, bearings, fuel systems, transmissions, chassis bearings, steering gears, springs, and rear-end design. Hypoid rear axles and their lubrication problems are discussed in considerable detail as the most important development in 1937 cars.

The chemical reaction characteristics of lubricants with various metals under various conditions of operation is predicted as the chief lubrication-research problem of the future. What to take out of, and what to add to, lubricants to make them suitable also will be of concern, the paper concludes.

Lubrication and Transportation Riddle for 1937 – *J. F. Winchester, Standard Oil Co. of N. J.*

That there is still a question about the types or kinds of lubricants after 25 years of automotive use – that the industry today has a method of rating lubricants that gives not one indication of their lubrication value – comprise the lubrication riddle for 1937, according to this paper.

Excessive taxation and regulation that shrink sales is cited as the transportation riddle. Automotive engineers and others affiliated with the industry are urged to contribute to the solution of this riddle by militant action, such as the formulation of sound codes and standards. In this connection emphasis is placed on motor-truck chassis ratings, and a comprehensive investigation along these lines is presented with its recommendations and conclusions.

Lubrication problems are compared with those of 25 years ago. In discussing the action and lubrication of hypoid gears the necessity for special lubricants is pointed out with the harmful effect of the wrong lubricants.

(*Continued on page 44*)

SAE Papers in Digest

(Concluded)

Washington Section Paper

Dec. 8, 1936

Safety in Air Transport – ***Col. Harold E. Hartney, technical adviser, Senate Safety Committee on Aeronautics.***

SAFETY problems in airplanes are considered more complex than those of surface vehicles because of their three-dimensional motion, although it is stated that much can be gained from the safety experience of the automobile and the bus.

The safer record of scheduled operation as compared with miscellaneous flying is attributed to the greater amount of instrument flying in the higher safety strata done in scheduled operation. It is shown that five out of nine accidents in this country occurred when planes were flying low in bad weather. Airlines can be made safer by not restricting their progress; more extended inspection; improved facilities for weather, radio, beacon terminals, and airports; and with greater factors of safety in design. Improvements in fuels, lubricants, spark-plugs, propellers, mixture controls, and storage batteries are recommended to increase safety.

Summing up, airline safety is compared with that of the railroads about the time when steel cars, double tracks, and the block system had just been adopted.

Metropolitan Section Papers

Jan. 18, 1937

Trends in Air-Transport Engine Design and Performance – ***Henry C. Hill, senior project engineer, Wright Aeronautical Corp.***

THIS paper discusses developments in the Wright Cyclone single-row, radial air-cooled aircraft engine over a period of twelve years.

The rise in horsepowers and speeds and decline in specific weights and fuel consumptions are shown graphically for this period. Notable in consideration of yearly sales and cost trends is the steady decline in dollars per horsepower. Comparison of 1000-hp. engines of ten years ago and today shows a weight saving of more than 1100 lb., a saving in fuel cruising consumption of 5 gal. per hr., and more than 32 in. decrease in overall diameter.

Taking the master rod and its assembly as an example, the paper shows how performance and reliability requirements are being met by three definite trends: the engine is rapidly becoming a more complicated mechanism; more and more attention is being paid to simplification of component parts; and more and more attention is being paid to the minute details of design.

Pratt & Whitney Twin Wasp SB3G Engine – ***A. V. D. Willgoos, chief engineer, Pratt & Whitney Aircraft.***

THIS engine, the Pratt & Whitney twin Wasp SB3G, was singled out for discussion in this paper as it represents a typical airline engine—exactly the kind being installed in the Douglas DC-3 transports for United Air Lines and little changed from the engines of the China Clippers.

Among the general specifications presented are that the engine is of the fourteen-cylinder, two-row radial air-cooled type with a normal rating of 900 hp. Examples of fuel consumptions well under the 0.48 lb. per hp-hr. guaranteed are cited.

The major part of the paper is devoted to a detailed description of the engine and its component parts – materials, construction, and functions.

Canadian Section Paper

Jan. 20, 1937

Anticipating Cooling Requirements – ***L. P. Saunders, Harrison Radiator Corp.***

IN this paper the increasing demands on automobile cooling systems are demonstrated. It is felt that these demands can be met by improvement in design and, as fundamental principles are involved, improvement can be obtained only by refinement in detail.

The difference in the volumetric heat capacities of air and water is shown to be one fundamental limitation that renders impossible theoretical proportioning of surfaces.

Effects on cooling – heat flow and dissipation – of the following factors are studied: thermal conductivity of various metals; air pressure, shape and arrangement of tubes; water and air velocity; anti-freeze-mixtures; and the design of valve chests, valve guides, cylinder-heads, exhaust manifolds, fans, grilles, and louvres.

Fuels & Lubricants Vice-President C. Herbert Baxley and Research Manager C. B. Veal are welcomed at Delft, Holland, by J. H. C. de Brey, president, and G. D. Boerlage, manager, Proefstation Delft, of N. V. De Bataafsche Petroleum Maatschappij. Mr. Boerlage is a prominent foreign member of the Society. Vice-President Baxley headed the SAE delegation which attended the World Petroleum Congress at Paris last June. Members of the delegation visited England, France, Germany, Holland and Belgium. *(Photo by George Calingaert)*

SAE Overseas Bonds Strengthened by Visits to 5 Countries

A DISTINCTLY closer rapprochement between the SAE and similar interests in Europe is to be anticipated as a result of the SAE's active advances made this summer and the effective and cordial response to them abroad. The original impetus for this special foreign activity was an invitation to participate and present papers at the Second World Petroleum Congress received from that organization's French secretariat. Of technical importance and interest to the SAE was also the meeting of the International Standards Association, scheduled for the same place and overlapping it in time, Paris, June 14. Radiating from these focal points there spread a general wave of closer cooperative activity, its manifestations being visits between SAE members from this and other countries, and contacts between the SAE and individuals, factories, and associations in England, France, Germany, Holland and Belgium. Anticipated results include an enrichment of the SAE in membership, professional activities, meetings, standards and research.

Accepting the invitation of the Second World Petroleum Congress to present papers were C. H. Baxley, SAE vice-president representing Fuels and Lubricants Activity, S. D. Heron, vice-chairman of the SAE Aircraft-Engine Activity, and C. B. Veal, research manager. Mr. Heron was represented by Dr. George Calingaert.

England

Messrs. Baxley and Veal arrived in England in advance of the World Petroleum Congress. Through the friendly offices of Lieut.-Col. M. F. Scanlon, U. S. Assistant Military Attache for Air, the British Air Ministry, the Institution of Automobile Engineers, Alex Taub, SAE Councilor, residing in England as engineer with Vauxhall Motors, Ltd., as well as other individuals, they were enabled to see many phases of British automotive and aircraft engineering. Among those individuals to whom the SAE representatives are particularly indebted for the kindly and effective interest, making possible the coverage of an extensive territory in the necessarily brief time available, are: Maj. G. P. Bulman, D. R. Pye, W. Lawrence Tweedie, British Air Ministry; H. Wood, Rolls-Royce, Ltd.; Lieut.-Col. L. F. N. Fell, chief engineer, Armstrong Siddeley Motors, Ltd.; Capt. G. S. Wilkinson, director in charge of engineering, and H. C. Tryon, D. Napier & Son, Ltd.; Capt. A. Swan, R.A.E.; F. R. Banks, technical representative, Ethyl Export Corp.; E. L. Bass, chief engineer, aviation department, Asiatic Petroleum Co., Ltd.; Capt. J. S. Irving, president of the I.A.E.; Brian G. Robbins, secretary, and C. G. Williams, director of research, I.A.E.; A. H. R. Fedden, chief engineer, Bristol Aeroplane Co., Ltd.; N. Mitchell, technical engineer, Asiatic Petroleum Co.; Dr. A. E. Dunstan and Richard Stansfield, Sunbury Laboratory, Anglo-Iranian Oil Co., Ltd.; James Kewley, chief chemist, Anglo-Saxon Petroleum Co., Ltd.; O. Thornycroft, superintendent, and Capt A. T. Evans, director of research, Ricardo & Co., Ltd.; S. J. Astbury, secretary, I.P.T.

At the factories and commercial laboratories visited, opportunity was given to view in actual operation the important automotive and aircraft-engine activity, both production and development, now being intensively manifested in Great

Britain. Visits were made to Bristol Aeroplane Co., Ltd., Armstrong Siddeley Motors, Ltd., Rolls-Royce, Ltd., D. Napier & Son, Ltd., Ricardo & Co., Ltd., Anglo-Iranian Oil Co., Ltd. (Laboratory at Sunbury-on-Thames).

Of equal interest were the non-commercial institutions with which contact was made. The Royal Aircraft Establishment at Farnborough offers an overall view of aircraft research, covering the whole range from aerodynamics to engines, fuels and lubricants, including both laboratory investigations and flight tests. Especially impressive are a gigantic altitude chamber for engine testing, and an investigation on the silencing of test stands.

Three divisions of the extensive research of the National Physical Laboratory at Teddington bear particularly on topics engaging the attention of SAE members, namely, the oiliness of lubricating oils, extreme-pressure lubricants, and aerodynamics. Representatives of the National Physical Laboratory spoke with high commendation of the researches of the National Advisory Committee for Aeronautics, under the leadership of Dr. George W. Lewis, chairman of the SAE Research Committee. The two organizations have established an exchange of information covering certain investigations. An invitation was also received to take part in a group visit to the Fuel Research Station of the Department of Scientific and Industrial Research.

The newly-established laboratory of the Institution of Automobile Engineers has been in operation for about a year, under the management of C. G. Williams. It has 30 employes and complete equipment, one item, for example, being eight single-cylinder engines. Its present program embraces fifteen projects ranging from the practical subject of brake squeaking to the scientific aspects of the significance of viscosity in lubricating oils. In conjunction with the laboratory a library is maintained, one of whose functions is the making and distribution to the automotive industry of abstracts of all important technical articles in its field. Financial support for this project comes partly from industry and partly from the Government.

Cornelis Van Vliet, American Petroleum Co., N. V. Gebouw Petrolea, Holland, another SAE Foreign Member. *(Photo by George Calingaert)*

Meetings attended included a Conversazione of the Institution of Civil Engineers. Features of this meeting were a reception by Sir Alexander Gibb, G.B.E., C.B., F.R.S., an exhibition of engineering models and scientific apparatus, which was sufficiently extensive to give the impression of presenting every phase of engineering and technical development throughout the Empire; lectures, including an address by C. F. Snowden Gamble on "The Empire Air Mails"; music and other entertainment. A meeting of the Subcommittee of the Institution of Petroleum Technologists was also attended. At this large gathering of technicians specializing in fuel detonation, final arrangements were made for the detonation road tests to be carried out in Great Britain in conjunction with the similar program now under way in the United States under the auspices of the Cooperative Fuel Research.

At the Robert Bosch A.G. plant in Stuttgart. *(Left to right)* C. B. Veal; Capt. J. S. Irving, president of the British Institution of Automobile Engineers and an SAE Foreign Member; and Dr. Erich C. Rassbach, director, Robert Bosch A.G., also an SAE Foreign member

I.A.E. Summer Meeting

The Institution of Automobile Engineers for its Summer Meeting this year toured Germany by motorcoach and train, and Mr. Veal accepted an invitation to accompany the party of about 150 persons made up of engineers and their families. Valuable features of the trip were the exchange of opinion and information with the British engineers, and visits to German factories which the Institution was able to arrange.

At the Gasmotoren Fabrik Deutz, at Cologne, in the firm's world-famous museum was exhibited a comprehensive history of the development of the internal combustion engine including the first four-cycle engine built by Dr. N. A. Otto, a pioneer of this company. In the factory fully equipped with the modern production tools, was witnessed in detail the extensive manufacture of all types of internal combustion engines.

A. A. Maynard and R. S. Begg, members of the SAE, took a prominent part in entertaining the party on its inspection trip to the Adam Opel A.G. and the luncheon given there. This factory, a German version of a typical American high-capacity plant, is contributing largely to the motorization of Germany. The internationally famous Robert Bosch works at Stuttgart were thrown open for inspection and every opportunity given for each visitor to inquire about details of production processes which especially interested him.

At the Elektronmetall works, Stuttgart-Bad Cannstatt, were seen an impressive array of equipment and personnel needed to turn out about 10,000 light alloy pistons a day. This factory is said to have a larger percentage of its country's business than is similarly enjoyed by any other factory in the world. The Elektronmetall company has for its chief aim development of engineering uses for aluminum, magnesium and their alloys, and numbers among its products light metal pressure die castings; fuel, oil and air filters; and elektronmetall airplane landing gears, wheels and brakes. At Stuttgart the opportunity was also given to visit Hann and Kolb, manufacturers of machine tools.

Inspection tours were made of both the body and chassis plants of the Daimler-Benz A.G., which was also host at a lunch to the party. At Friedrichshafen, the sister ship of the

At Elektronmetall Works in Cannstatt, Germany

F. G. Woollard, an SAE Foreign Member, was spokesman for the group of Institution of Automobile Engineers members. Standing, he is replying to a speech of welcome from SAE Foreign Member, Dr. Ernst Mahle, Elektronmetall president, seated at his left. C. B. Veal, at Mr. Woollard's right, was a guest of the English engineers on the trip to Germany.

Hindenburg, nearing completion, was shown and its design details explained. Work on this ship had been suspended, pending any changes in construction and plan of operation which might be occasioned by the use of helium instead of hydrogen gas.

Social features of the tour included a reception by the City of Cologne, an official evening reception at Wiesbaden, a luncheon tendered by the City of Stuttgart, a banquet given by Robert Bosch A.G., and the I.A.E. banquet and dance. An especially interesting feature of the traveling through Germany was the use of one of the new State Arterial Highways (Reichsautobahnen).

France

At the Second World Petroleum Congress, Paris, June 14 to 19, were gathered about 1600 technical men engaged in the engineering phases of petroleum production, processing and utilization. Thirty-three countries were represented, and 392 papers were contributed. The Association Francaise des Techniciens du Petrole was responsible for the organization of the Congress, especially active in this work being Ch. Bihoreau, director of the Technical Bureau of the Office National des Combustibles Liquides, president of the Congress, and J. Filhol, chief of the Information Bureau of this Institution and general secretary of the Congress.

At the opening business session, held on the morning of June 14, Col. Louis Pineau, director of the Office National des Combustibles Liquides, was elected Honorary President of the Congress. Leon Blum, the President of the French Republic, was Honorary Chairman of a well attended general inaugural meeting held on the afternoon of the same day. The United States was represented on the Council of the Congress by Dr. Gustav Egloff, president of the National American Committee of the Section P.C.R. and by Dr. W. P. Haynes, president of the American Association of Petroleum Geologists. An important decision made by the Congress was to maintain a standing committee and a permanent secretariat in London. The delegates of the SAE to the Congress were: Vice-President Baxley, chairman; Dr. George Calingaert, T. A. Weir, of the Socony-Vacuum Oil Co., Inc.; Alex Taub, Vauxhall Motors, Ltd., and C. B. Veal.

Two of the three contributions by SAE members to the technical sessions were made before Section IV, Utilization; one, that by Mr. Veal, before Section V on Economics and Statistics. Other sections dealt with Geology and Drilling, Physics, Chemistry and Refining, and Material and Construction. "Methods of Equipment Used in the Development of Lubricants for High Output Service with Special Reference to Aviation Oils" was the title of the paper by Mr. Baxley and J. P. Stewart. It described a single-cylinder oil testing plant, emphasizing particularly the necessity for flexibility and careful control needed in such a unit. The paper prepared by S. D. Heron and Ferd Gillig, of the Research Laboratories, Ethyl Gasoline Corp., entitled "Supercharged Knock Testing," reported an investigation of the variations in antiknock value of a group of representative aircraft-engine fuels of high antiknock value with a variety of knock test methods. A supercharged C.F.R. engine with systematically varied engine conditions is being used in the investigation. Under the title "Cooperative Research and Standardization for Automotive Petroleum Products in the United States," Mr. Veal presented a summary of the work being done in this field by the Cooperative Fuel Research, the American Society for Testing Materials, the American Standards Association, and the SAE.

In connection with the Congress, inspection trips were offered to the Laboratoire de la Compagnie Francaise de Raf-

Robert Bosch welcomes his guests to a dinner which his company tendered to visiting IAE and SAE members.

finage, Usine de Constructions Babcok et Wilcox, Société des Automobiles Renault, Compagnie Generale de Geophysique, Pompes Guinard, Compagnie des Compteurs, Musee de l'Air, and Office National des Combustibles Liquides, Station Nationale de Recherches et d'Experiences Techniques de Bellevue.

Due to conflict with other engagements, the SAE delegates were unable to make the scheduled trip to Bellevue, but were especially indebted to G. Bonnier, A. Labarthe, chief of the Testing Service, and Louis Thaler, Ingenieur Civil de l'Aeronautique, for arrangements made for a special visit to the laboratory.

Members of the Congress enjoyed personal contact with each other through a number of varied social events, an official banquet, a reception tendered by the Chambre de Commerce de Paris, a luncheon under the auspices of the Association Francaise des Techniciens du Petrole, and an afternoon and evening spent at Versailles, including visits to the Chateau de Versailles and the Trianon, a dinner in the Orangerie, and a brilliant night fete of music, dancing, illumination of the fountains and fireworks.

Technically, industrially and commercially significant were the meetings of the ISA, held concurrently with and following the Petroleum Congress at which Mr. Veal was the official representative of the American Standards Association, the member body for the United States. Much credit is due H. Huber-Ruf, general secretary of ISA, for the smoothness with which the extensive and complicated program of meetings was carried through. At the five meetings of ISA Committee 22, Automobiles, Maurice Berger, president, was particularly helpful to English-speaking delegates, providing translations and enabling them to take active part in the proceedings. John Ide represented the SAE at the four sessions of Committee 20, Aeronautics. A procedure which promises to yield favorable results was instituted by Committee 28, Petroleum, which held two meetings. Topics were assigned to individual countries, which shall be responsible for carrying on the projects within that scope in the interim between committee meetings.

Friday, June 18, was signalized by two events exemplifying the cordial relations existing between our French sister society, the Societe des Ingenieurs de l'Automobile, and the SAE.

On the invitation of Pierre Prevost, president of the SIA, the four SAE delegates at the Petroleum Congress and several members of the SIA council met at luncheon at the Automobile Club de France. With Maurice Goudard, past-president of the SIA in the chair, discussion was had of a proposal made by the French society for a formal scheme of active cooperation between that body and the SAE. This was the outgrowth of several months of investigation and correspondence between the two societies, in which Henry Lowe Brownback, consulting engineer of Norristown, Pa., member of both the SIA and the SAE, has acted as the point of contact. The proposal made was that an American section of the SIA should be established in the United States, and a French section of the SAE in France. The rules and organization of the sections should be similar to those of the parent bodies. The membership would be composed of those already belonging to the respective societies, but residing abroad, and of new members, the recruiting of whom would, it is expected, be furthered by the plan.

To the meeting of the Research Section of the SIA, held on the evening of June 18, all SAE members then in France were invited. An illuminating discussion of the fundamental theories of detonation was had, on the basis of papers presented by Max Surruys, Ingenieur E.C.P., Docteur des Sciences, Collaborateur Exterieur du Ministere de l'Air, and G. D. Boerlage, manager, N. V. de Bataafsche Petroleum Maatschappij, Proefstation Delft.

During the entire stay of the SAE delegates in Paris, Henri Pagny, aeronautical lubricating engineer of the Vacuum Oil Co. for France, Belgium and Holland, was especially helpful, arranging for, among other things, an inspection trip to the Gnome-Rhone factory, special luncheons and other contacts with French engineers. Jacques Blanc, technical director and chief engineer, acted as host at the visit to the Gnome-Rhone factory and the luncheon given in connection with it.

Belgium

While no inspection trips of technical importance were made in Belgium, the good fellowship and helpfulness of Dr. Pierre Lamal, ingeneur, director du Journal des Petroles, John Pawloski, export production manager, General Motors Corp., and J. W. Flanagan, special service representative, Chrysler Export Corp., contributed to the stay of the American visitors on the Continent. Especial thanks is due Mr. Flanagan, who made available a car and driver, which greatly facilitated travel through Germany and Holland.

Germany

In Germany as elsewhere, the SAE delegates were indebted to those in authority for their cordiality and efficiency in handling the itinerary of inspection trips to places of engineering interest.

Through the kind offices of Prof. Dr.-Ing. Adolph Nagel, of the Sachsische Technische Hochschule, and Dr. Erich C. Rassbach, of Robert Bosch, A.G., Messrs. Veal and Baxley received invitations to the 75th Annual Meeting of the Verein Deutscher Ingenieure, in the National Socialist Union of German Engineering, held from June 28 to July 2, at Kiel. In attendance were about 2000 engineers, representing every branch of the profession, which, with the insistence and encouragement of the Government, is devoting itself to the strenuous efforts now being put forth to develop and utilize to the utmost Germany's natural resources. Two crowded days saw eleven well-ordered, well-attended technical sessions of distinct engineering value. In connection with the VDI meeting, a reception was given on the American battleships, Arkansas, New York and Wyoming, then on a visit to Kiel, to officers of the German Navy and their ladies. In addition, there were two other social events, a general meeting, a meeting for young engineers, a day spent on and with the German fleet, and 13 other visits to plants and places that had engineering lessons to teach. A solemn, dignified and beautiful service in honor of the German sailor dead during the Great War was held at Laboe, where the curious and striking memorial structure, designed to resemble a section of a ship's prow, breasts the winds from the Baltic and the open sea.

Papers bearing on the automotive and allied fields were given at several of the technical sessions. Testing, methods of handling aluminum and corrosion were topics of the welding session. An excellent paper on automotive suspension was included in the vibration and sound session. The corrosion session dealt with the corrosion of light metals subjected to salt air, and the effect of raw material working on corrosion protection. One raw material question dealt with was the possibilities of the uses of magnesium alloys in German industries.

Following his attendance at the VDI meeting, Mr. Veal was enabled, through the kindness of Dr. Nagel, the director, to see and learn personally something of the fuels and lubricants research being carried on at the mechanical engineering laboratory of the Sachsische Technische Hochschule, at Dresden. Here Dr.-Ing. Karl Zinner and E. Blaum, showed the apparatus used and explained in detail the current investigations on combustion, particularly those dealing with Diesel fuels, including gas oils.

Through the contacts made at the VDI meetings, and the kindly offices of Major Smith, U. S. Military Air Attache, and Baron Graf Beisel, attache secretary, Air Ministry at Berlin, Messrs. Baxley and Veal were enabled to visit factories and laboratories in Germany. Others whose friendly interest helped to make their stay pleasant and profitable were Friedrich-Karl Freiherr Koenig, von und zu Warthausen, Otto J. Merkel, Dr. mont. E.h. Otto Petersen, Dipl.-Ing. Emil Kropf, Erich Syamken, and W. W. "Chick" White.

The high regard in which the SAE is held was manifested by the cordiality and good will of Adolph Baeumker, Ministerialrat und Abteilungschef im Reichsluftfahrtministerium. Herr Baeumker is also president of the Lillienthal Society, the German technical association for aviation, covering both practical and scientific phases. When, in response to his invitation, the SAE representatives visited the new huge and beautifully appointed Air Ministry Building, Herr Baeumker explained that the organization of the Lillienthal Society was deliberately patterned after that of the SAE. He also expressed the whole-hearted willingness of his Society to cooperate with the SAE in all matters, except those, which lying within the province of the Air Ministry, are confidential in nature. Another engineer connected with the Air Ministry with whom contact was made was Dipl.-Ing. Frido Kirchhoff, in charge of the new rather sensational helicopter development.

The Deutsche Versuchsanstalt fur Luftfahrt more than lives up to its reputation for completeness and thoroughness of aircraft research. The entire range of aeronautic interest comes within the sphere of its investigations, covering all material from complete aircraft to raw materials of operation, and all phases, the purely scientific and the highly practical. The organization of this comprehensive establishment into a large number of logically and accurately delineated departments is a beautiful example of German management and efficiency. The results attainable are shown by the rapidity with which the building, plant and equipment have been expanded within the last two and a half years. Dr.-Ing. E. F. Seewald, manager of the D.V.L. laboratory, received the SAE representatives on their visit there, and made arrangements for their inspection trip, which was conducted by Drs. Hansen and Smidt and Dipl.-Ings. Lesser and Zeeber. Dr. A. Von Phillipovich also assisted in explaining the fuel research of the D.V.L., emphasizing the advantages to be attained by cooperation between his department, other fuel research agencies in Germany and the C.F.R.

All aspects of the development and use of the Junkers Diesel aircraft engine were shown to the SAE representatives. At a visit to the overhaul plant of the Deutsche Lufthansa, A.G. at Staaken, personally conducted by Baron Graf Beisel, and made possible through the kindness of Dr.-Ing. Rudolf Stussel, the company's chief engineer, and others, the engines were seen both in service and torn down for inspection after operation. Technical Works Manager Flohr directed the trip through the overhaul plant. The factory of the Junkers Flugzeug-und-Motorenwerke A.G. at Dessau is devoted to experimental and development work and the building of small production orders. There were shown and fully explained the research and manufacturing processes. The establishment at Dessau is new, with fine buildings in a park-like setting (typical American University Campus), including a large flying-field and provisions for employes' athletic and social recreation, including dining rooms for all. Dipl.-Ing. Ferdinand Flinsch, William Hoener, and W. Echenberg were the courteous hosts, willingly and carefully describing the plant and answering the numerous questions put to them.

Chief Engineer F. W. Wendt conducted the SAE representatives through the Daimler-Benz Works No. 9, at Berlin, where are built 30 liter, high-output liquid-cooled aircraft engines, ruggedly designed and constructed especially for altitude performance. This factory is also new, and noticeable features are its extensive array of modern machine tools, its exceedingly quiet test stands, cleanliness, precision and regularity of its production routine. A fine quality of high-precision workmanship is displayed.

Holland

G. D. Boerlage, SAE's good and oldtime friend, organized the Regional SAE meeting held on the occasion of the visit to Holland of Dr. Calingaert, and Messrs. Baxley and Veal. The contagiousness of his enthusiasm and the quality of his management resulted in a 100 per cent attendance of Dutch SAE members, probably a new all-time record for an SAE regional meeting. About half of the 50 or more technical men at the meeting were SAE members. Included also were one representative each from Belgium, Italy and France.

The technical sessions of the meeting were held during the morning and afternoon at the Delft testing station of the N. V. de Bataafsche Petroleum Maatschappij. Mr. Boerlage and J. J. Broeze gave the main general talks describing the organization of the laboratory, the nature of its activity and work in progress, touching also on some of its earlier accomplishments. On a trip through the laboratory, the equipment and methods used in the studies of combustion, fuel and lubricant problems were demonstrated and explained, individual topics being dealt with by L. A. Peletier, A. van Driel, A. G. Cattaneo, G. A. Bouman and H. Blok. Among various exhibits may be mentioned the single-cylinder aviation engine set-up for research on high-octane fuels; the engine with quartz windows for flame photography; several high-speed Diesel engines of different types and sizes for investigating Diesel fuel behavior.

A special division of this laboratory is concentrating on oiliness and E.P. lubricants research. Here the SAE E.P. lubricants testing machine and the "four-ball apparatus" developed by the Delft laboratory itself were shown, along with various gear testing units. Novel rating methods – such as the "A.B. ratio" knock rating method on the supercharged C.F.R. engine – were demonstrated.

J. H. C. de Brey, president of the N.V. de Bataafsche Petroleum Mij., on behalf of the company, was host at a luncheon given at the Ypenburg airport, near Delft, at which he briefly sketched the origin and general theory behind the development of the Delft testing station. A dinner and social meeting was held in the evening at Schevegingen, the Atlantic City of Holland. The quantity and quality of attendance, the technical interest and spirit of cordial friendliness of the entire meeting set a standard which it would be difficult to excel.

On the following day, G. T. L. Caviet, of the general chemical laboratory of N. V. de Bataafsche Petroleum Mij., entertained the American visitors at luncheon after an inspection of the large, modern and diverse laboratory of the company at Amsterdam. Employing more than 1000 persons, this laboratory carries on routine testing and investigates in its research all phases of petroleum chemistry, from geological to molecular and atomic studies, acts as standardization body for all Royal Dutch Shell laboratories, makes a variety of tests for the Government and operates a general laboratory.

The friendly reception and technical interest of the stay in Holland were typical of the entire European trip, and indicate the avenues through which future profit to the SAE is to be expected: greater knowledge on our part of the organization and methods of European factories, government institutions and societies: friendships gained and fostered for the SAE, and definite plans projected for future cooperation abroad.

News of the Society

Field Editors

Baltimore – Espy W. H. Williams
Buffalo – G. W. Miller
Canadian – Warren B. Hastings
Chicago – Austin W. Stromberg
Cleveland – William G. Piwonka
Dayton – Mearick Funkhouser
Detroit – William F. Sherman
Indiana – Herman Winkler
Kansas City – No Appointment
Metropolitan – Leslie Peat
Milwaukee – Theodore L. Swansen
New England – J. T. Sullivan
No. California – C. W. Spring
Northwest – R. J. Hutchinson
Oregon – Philip Cogswell
Philadelphia – H. E. Blank, Jr.
Pittsburgh – Murray Fahnestock
St. Louis – C. T. Schaefer
So. California – W. G. Chamberlin
So. New England – John G. Lee
Syracuse – No Appointment
Washington – Capt. E. L. Cummings

SAE Men Prepare Papers For International Forum

Eight SAE members are preparing papers to be presented at the General Discussion on Lubrication and Lubricants, sponsored by the Institution of Mechanical Engineers, to be held in London, Oct. 13-15. These men, who have been invited to participate by C. Herbert Baxley, SAE vice-president representing the Fuels & Lubricants Activity, at the request of the I.M.E., are: D. P. Barnard, assistant director of research, Standard Oil Co. (Ind.); SAE Vice-President A. L. Beall, research engineer, Wright Aeronautical Corp.; A. W. Burwell, vice-president, Alox Corp.; H. A. Everett, head of mechanical engineering department, Pennsylvania State College; F. L. Miller, in charge of lubrication and lubricants research, Standard Oil Development Co.; G. L. Neely, research engineer, Standard Oil Co. of Calif.; C. G. A. Rosen, engineer in charge of Diesel development, Caterpillar Tractor Co.; Alex Taub, powerplant development, Vauxhall Motors, Ltd.

It is expected that 140 papers from lubrication authorities throughout the world will be presented at this forum which has the cooperation of 29 British societies and technical institutions and 19 similar bodies in other countries.

Aside from the above men who have been invited by Vice-President Baxley to prepare papers, the following members of the Society are listed by the I.M.E. as having promised to submit papers for this conclave: S. A. McKee, National Bureau of Standards; D. P. C. Neave, Copper Development Association, London; H. M. Richardson, General Electric Co.; C. H. Barton, Asiatic Petroleum Co., London; E. L. Bass, of the same company; G. D. Boerlage, Royal Dutch Shell, Delft, Holland; O. T. Jones, Vacuum Oil Co., London; E. C. Ottaway, London Passenger Transport Board; C. Fayette Taylor, Massachusetts Institute of Technology; R. Coulson, Renold & Coventry Chain Co., Coventry, England; H. E. Merritt, Yorks, England; J. C. Geniesse, Atlantic Refining Co.; Gordon McIntyre, Imperial Oil Co., Ontario, Canada.

E-P Lubricants Testing Machine Owners

Thirty-seven companies have purchased one or more SAE Extreme-Pressure Lubricants Testing Machines and are cooperating with the SAE E-P Lubricants Research Committee in making test runs.

The original lot of 21 machines was delivered in 1935, a second lot of 10 machines was produced in 1936 and the third lot of 10 machines is now being built. All machines are of the same design and give comparable results under similar conditions. They are built to SAE specifications by the Highway Trailer Co., Edgerton, Wis.

Companies owning E-P Lubricants Testing Machines are: Anglo-Iranian Oil Co., Ltd.; The Atlantic Refining Co.; Cadillac Motor Car Co.; Chrysler Corp.; Cities Service Co.; Continental Oil Co.; Robert F. Cruickshank Corp.; N. V. De Bataafsche Petroleum Maatschappij; E. I. DuPont de Nemours & Co., Inc.; Fiske Brothers Refining Co.; General Motors Corp.; Gulf Oil Corp.; Gulf Research & Development Co.; Kendall Refining Co.; The Lubri-Zol Corp.; Packard Motor Car Co.; Shell Petroleum Corp.; Sinclair Refining Co.; Socony-Vacuum Oil Co., Inc.; Standard Oil Co. of Calif.; Standard Oil Co. (Ind.); Standard Oil Development Co.; D. A. Stuart & Co., Ltd.; Sun Oil Co.; Swan-Finch Oil Corp.; The Texas Co.; Tide Water Associated Oil Co.; Timken Roller Bearing Co., and Union Oil Co. of Calif.

Veal Attends International Standards Meeting

A portion of the 84 delegates from 10 countries attending the International Standards Association technical sessions on automotive standardization held in Paris, June 21-22. Seated second from the right on the far side of the table is C. B. Veal, SAE research manager, who represented the United States at these meetings.

At the head of the table is Maurice P. Berger, director of the French bureau of automotive standardization, a foreign member of the SAE since 1928.

Among the countries represented were the United States, France, Germany, Great Britain, Italy, and Czechoslovakia.

The meetings on automotive standardization were a part of a series of ISA conferences on 24 subjects held in Paris, June 14-26, at the invitation of the Association Francaise De Normalisation. Total attendance included 220 delegates from 17 countries. Mr. Veal attended sessions which centered on automobiles, aeronautics and petroleum products.

Student Branch Elects 1937-1938 Officers

• G.M.I.

Concluding its 1936-1937 year with a dinner for 35 members and guests the Student Branch at General Motors Institute announced officers for the coming year as follows: Louis White, chairman-at-large; W. Hasbany, vice-chairman, section A; M. Perish, vice-chairman, section B; R. F. Grogan, secretary-treasurer, section A, and W. F. Boyer, secretary-treasurer, section B.

Graduating Student-Branch members were honor guests of the occasion and Retiring Chairman P. H. A. Ball was presented with a gift in appreciation of his work for the past two years.

Capt. Horace Stark, first pilot, F. R. Clemins, district traffic manager, and W. C. Wilson, local station manager, all of the Pennsylvania Air Lines, told some of the problems encountered in modern airline operation. Captain Stark showed an instrument he had designed to assist in blind flying.

At an earlier meeting Student Branch members inspected the plant of the Marvel Schebler Carburetor Division of Borg-Warner Corp. Carl F. High, of that company, was speaker at the dinner which followed the trip. His subject was "Fuel Inspection and Carburetion."

Drawings Available for V-Belt Testing Machine

Working drawings have been prepared by the SAE Standards Committee from which a machine may be constructed to test V-belts by methods given in the new SAE Standard for V-Belts and Pulleys (1937 SAE HANDBOOK, pp. 60-63).

The design of the fixture has been made as simple as possible to give uniformly comparable results and long service.

These drawings (SAE Nos. 7-7-10 and 7-711) are available to members of the Society at 50 cents per set; to non-members at $1.00 per set. Orders should be addressed to Standards Department, Society of Automotive Engineers, 29 West 39th St., New York.

Compensation

To compensate New England Section Treasurer Albert Lodge for his monthly 200-mile trips from Greenfield, Mass., to Section and Governing Board meetings in Boston during the winter, the New England Section Governing Board held its first 1937-1938 meeting in Greenfield, July 28. Twelve members of the board made the trip from Boston. After business was taken care of dinner was served and the meeting adjourned to links of the Country Club of Greenfield where the meeting was held.

Unauthorized Use of SAE Steel Numbers Misleading

The system of numbering that was adopted by the Society many years ago for designating SAE Standard steel compositions is generally recognized and widely used throughout the automotive and associated industries and many other general industries that are steel consumers. These numbers denote specific compositions that have been officially approved and adopted by the Society and have been made available to the steel producing and using industries.

With the development of this almost universal recognition and use of SAE steels and their designating numbers, instances have arisen from time to time of the unauthorized use of the numbering system for compositions that are not included in SAE specifications. In some instances these numbers are used without a prefix but in some instances the prefix "SAE" has been a part of the designation.

Such use of the SAE numbering system, particularly with the prefix "SAE," for designating compositions that are not included among those in the SAE Standard is misrepresentative, usually unintentionally so, and is misleading and confusing.

The Society is not, of course, in a position to take action towards prohibiting such unauthorized use of the numbering system but it calls attention to the impropriety of doing so.

One of the reasons for this is that old steel compositions go out of use and new compositions are adopted as the industries progress, the cycle of such changes being from three to five years. The unauthorized use of a number for a steel of some special composition other than those included in the SAE Standard would tend to more or less permanently identify that special composition with that number.

Eventually the Society might adopt a composition perhaps similar to the special one already introduced but would find itself prevented from using the proper number officially because of its prior use unofficially. This would not only handicap the Society in periodically keeping its specifications thoroughly up to date and consistent with the numbering system but would lead to considerable confusion throughout the industries.

SAE steel specifications are probably the most widely known and used of all the SAE Standards and accordingly it is of real importance that practices be avoided which would either handicap the Society in keeping these specifications up to date periodically or which would result in general confusion through the unauthorized application of the numbering system or numbers to non-standard compositions.

Ancient Cars Background For "Members Only" Forum

• Detroit

Edison Institute in famous Greenfield Village will be the Detroit Section's meeting place, Sept. 27. There, amid cars dating from 1863 to the present, three papers will be presented on development of materials, engines, chassis and bodies. This will be a closed session, open only to members of the Society. A special display of old and new parts will be shown in connection with the program. Before the meeting dinner will be served at Dearborn Inn.

Historical Data Wanted

The Society archives hold but one copy each of three early SAE Rosters – for the years 1915, 1916 and 1917. As it is desirable to keep such records in duplicate, donation of these books by members having spare copies will be welcomed by the Society. During these years the rosters bore the title, "List of Members, Officers & Committees."

SAE Men Assist in Running San Francisco's Soap Box Derby

As more than 115 boys of the San Francisco area competed in that city to determine the Section's representative in the finals of the Chevrolet Soap Box Derby held in Akron, Aug. 15, SAE men were on hand to help make the event a success. Robert W. Martland, Jr., editor, *Radco Publications* (at left), was in charge of all preliminary derbies held in Pacific Coast cities. SAE members J. R. MacGregor, E. J. McLaughlin and W. V. Hanley, of the Standard Oil Co., and Carl W. Spring and L. R. Firsch of the Shell Oil Co., worked with him during the San Francisco event.

According to Mr. Martland, "The most significant observation of the technical men was the impossibility of predicting winners. Prior to the race competent SAE men calculated that coasters with fast wheels, built close to the gross weight limit of 250 lb., and ably driven would have a better chance than lighter coasters. Study of final data disproved practically every theory advanced."

About SAE Members: . . . . *At Home and Abroad*

R. P. Russell has been appointed executive vice-president of Standard Oil Development Co., and under F. A. Howard, president, will assume general executive responsibility. Heretofore Mr. Russell was vice-president and general manager of the company.

George D. Evans, assistant aeronautical engineer, ships experimental unit, has been transferred, with his organization, from Naval Air Station, Norfolk, to Naval Aircraft Factory, Philadelphia.

F. M. Kincaid, Jr., has joined the Wright Aeronautical Corp., Paterson, N. J., as designer and layout man. He was formerly with the Waukesha Motor Co., Waukesha, Wis.

Clayton Farris has been elected vice-president and general manager of the National Motor Truck Show, Inc., which will hold its fourth annual exhibition in Newark, N. J., Nov. 6-12.

Francis Rodwell Banks has been named assistant secretary of Ethyl Export Corp., London, foreign subsidiary of the Ethyl Gasoline Corp. He has been in charge of the technical work of the export company since 1930. Previously he had been connected with the technical department of the Anglo-American Oil Co.

F. R. Banks
Advanced

On Federal Air Board

Included in the personnel of the newly formed Bureau of Air Commerce Advisory Board are the following SAE Members: Dr. George W. Lewis, director of aeronautical research, National Advisory Committee for Aeronautics; Rear-Admiral Emory S. Land, member of the United States Maritime Commission; Leighton W. Rogers, president, Aeronautical Chamber of Commerce, and Col. Edgar S. Gorrell, president, Air Transport Association of America.

This advisory board has been formed by the United States Department of Commerce to consider "important national aeronautical problems and the formulation of national policies with respect thereto," according to an announcement in a recent issue of the Department's Air Commerce Bulletin.

John Dickson, formerly affiliated with Hooven, Owens, Rentschler Corp., has been named assistant chief engineer, Diesel division, General Motors Research Laboratories, Detroit. He is a member of the Diesel Engine Division of the SAE Standards Committee.

J. D. Gayer has joined the General Electric Co., Philadelphia works, as junior engineer in machine design. He was formerly a student at Ohio State University.

Frank G. Alborn, formerly chief engineer of the White Motor Co., Cleveland, will devote his time to automotive consulting work, with an office in Norwalk, Conn. His address is P. O. Box 327, Norwalk.

F. G. Alborn
Consultant

Paul C. Spiess is now affiliated with the Bureau of Air Commerce at Union Air Terminal, Burbank, Calif. He was previously engineer with the Crusader Aircraft Corp., Glendale.

Millard C. Rowley, former analytical engineer with Lycoming Manufacturing Co., Williamsport, Pa., is designer with Hamilton Standard Propellers, East Hartford, Conn.

A. H. Lau Fer, recently elected chairman of the Society's Northern California Section, has joined the staff of Marvel Carburetor Sales Co., San Francisco. He was previously sales and service engineer, Julius Brunton & Sons Co., of the same city.

H. K. Cummings, chief, automotive power plants section, National Bureau of Standards, has been appointed by the SAE Council to represent the Society in the American Documentation Institute.

John H. Hunt, director, new devices section, General Motors Corp., spoke before a luncheon held by the Flint Rotary Club, Aug. 6. His subject was "New Devices."

A. J. Brandt has been named president of the National Tool Co., Cleveland.

Alex Taub, powerplant development, Vauxhall Motors, Ltd., and a member of the SAE Council, visited Headquarters while in this country to attend his son's wedding which took place on his and Mrs. Taub's silver wedding anniversary. He arrived in New York on July 22 and sailed for England Aug. 21.

Paul G. Hoffman, president of the Studebaker Corp., spoke before the traffic engineering training school at Harvard University on Aug. 16.

R. L. Morrison
General Manager

Raymond L. Morrison has been named general manager of the Bendix-Westinghouse Automotive Air Brake Co., Pittsburgh. In this capacity he will fill the vacancy resulting from the recent death of Robert M. Heinrichs. Mr. Morrison was formerly district manager of the company with offices in Detroit. He joined the Westinghouse Air Brake Co. in 1915 and was transferred to the company's automotive division in 1926.

Dr. F. O. Clements, technical director, General Motors Research Laboratories, and past-president of the American Society for Testing Materials, has presented that society with approximately $7,000 to be added to the principal of the A.S.T.M. Research Fund. The gift is in the form of shares of General Motors Corp. common stock.

Joseph Liston has terminated his connection with the school of mechanical engineering, University of Oklahoma, to join the staff of Purdue University as assistant professor of aeronautical engineering.

Dr. Miller McClintock, director, Harvard University Bureau for Street Traffic Research, is touring Germany, Holland, England and France. While in Germany he plans to study the super-highways being constructed in that country.

Capt. O. A. Axelson, automotive and safety engineer, Columbia Gas & Electric Corp., New York, and ***H. O. Mathews,*** automotive engineer, Public Utilities Engineering and Service Corp., Chicago, have been appointed to membership on the Transportation Division of the Standards Committee. Their appointments were approved by the Council at its July 16 meeting.

On Chrysler Board

Owen R. Skelton **Carl Breer**

SAE Members Carl Breer and Owen R. Skelton, Chrysler executive engineers, have been named to the board of directors of the Chrysler Corp. These two men have been long associated with Walter P. Chrysler and have contributed greatly to the design of Chrysler products. Mr. Breer has been a member of the Society since 1920 and Mr. Skelton since two years later.

(*Continued on page 25*)

Second Annual SAE

National Aircraft Production Meeting

Oct. 7-9 Los Angeles Ambassador Hotel

THE Army and the Navy . . . builders of aircraft and engines . . . transport companies . . . makers of factory equipment . . . suppliers of raw materials . . . the National Advisory Committee for Aeronautics . . . are all contributing papers based upon theory and practical experience that will mark the Second SAE National Aircraft Production Meeting an all-important event in aviation's 1937 history.

Seven technical sessions . . . an inspection trip through the famous laboratories of the California Institute of Technology . . . an aviation banquet . . . will keep interest high throughout this three-day meeting.

Production subjects of current interest will get serious debate at this national forum. Such problems as engine maintenance and installation will be expressed from the operators' point of view – and in discussion manufacturers will tell "why" and what improvements are in store.

Stainless steel and its place in aircraft manufacture will be explained by a representative of one of the country's leading users of this material – the E. G. Budd Mfg. Co. Steel castings, magnesium castings, die castings and molded plastics will all get concentrated attention.

A paper is expected on production problems in the manufacture of aluminum alloys. This, with another devoted to hydro-press operations, will be featured at the all-important session on Aircraft Processes.

"Factory Equipment and Tooling" and "Production Tools for Airplanes" are the titles of two vital papers that will comprise the Factory Equipment Session. Representatives of the Army and the Navy will tell of problems that occur in keeping fit the Nation's first line of defense.

Working with SAE President Harry T. Woolson and Vice-Presidents A. L. Beall (aircraft-engine) and Fred E. Weick (aircraft), General Chairman Carleton E. Stryker and Activity Meetings Representatives Peter Altman (aircraft) and S. D. Heron (aircraft engine), are putting finishing touches on the program. The Southern California Section is cooperating in making local arrangements.

Among the authors preparing papers are such authorities as: Donald H. Wood of the National Advisory Committee for Aeronautics; A. Lewis MacClain, chief test pilot, and R. S. Buck, project engineer, Pratt & Whitney; Henry A. Berliner, president, Engineering & Research Corp.; Col. E. J. W. Ragsdale, E. G. Budd Manufacturing Co.; Robert Johnson, Wright Aeronautical Corp.; D. M. Carpenter, production manager, and J. Van Doren, chief of tool design, Consolidated Aircraft Corp.; H. Oliver West, chief engineer, United Air Lines; Maj. Joseph T. Morris, U. S. Army Air Corps; and Fred Arnold, Naval Air Station, San Diego.

(*Continued on page 28*)

General Chairman Stryker with a Future Aviation Expert

Photo by SAE Journal Field Editor W. G. Chamberlin

General Chairman Carleton E. Stryker gets keen attention as he describes landing-gear mechanism for the benefit of a young enthusiast. This is Mr. Stryker's second year as general chairman of the National Aircraft Production Meeting. He is chief engineer of the Curtiss-Wright Technical Institute.

Here Are Programs For

Section Regional

TRANSPORTATION MEETING

Chicago *Sept. 29 to Oct. 1*

Blackstone Hotel

The Chicago Section, sponsor of this meeting, will have the cooperation of the Transportation and Maintenance and the Truck, Bus and Railcar Activities.

Wednesday, Sept. 29

Afternoon

Rating a 14,000 lb. Gross-Vehicle-Weight Motor Truck – FRED L. FAULKNER, manager, automotive department, Armour & Co.
Rebuttal of this paper will be made by engineers from the following truck manufacturing companies: White, G.M.C., International Harvester, Chrysler and Autocar.

Evening **Dinner Meeting**

Methods of Evaluating Extreme-Pressure Lubricants – C. A. CROWLEY, director of research, Technical Service Bureau.

Thursday, Sept. 30

Morning

Sound Proofing and Ventilation of Motor Cars, Buses and Railroad Cars – R. F. NORRIS, in charge of acoustic research, C. F. Burgess Laboratories, Inc.

Afternoon

Economics of Retreading Tires – PHILIP H. SMITH, Technical Investigator.

Friday, Oct. 1

Morning

Bus Maintenance – this paper to be presented by the maintenance manager of a leading bus transportation company.

Afternoon

Inspection trip through the plant of the Electro-Motive Corp.

Section

TRACTOR

Akron, Ohio

Mayflower Hotel

Sponsored by the Cleveland Section with cooperation of Tractor and Industrial Power Equipment Activity.

Wednesday, Sept. 15

9:30 A.M. C. E. FRUDDEN *Chairman*

Special Applications of Tractor Tires and Implement Tire Problems – J. G. KREYER, Firestone Tire & Rubber Co.
Water in Tractor Tires – H. W. DELZELL, B. F. Goodrich Rubber Co.

Afternoon

J. G. SWAIN & E. F. TOMLINSON *Chairmen*

Plant visits to Goodyear Tire & Rubber Co. and B. F. Goodrich Rubber Co.

Thursday, Sept. 16

9:30 A.M. J. E. HALE *Chairman*

Plant visit to Firestone Tire & Rubber Co.

2:00 P.M. ELMER McCORMICK *Chairman*

Functions of the Tire and Rim Associa-

3 Big SAE Meetings

Regional

MEETING

Sept. 15 to 17

tion – C. L. WENZEL, president, Tire & Rim Association.

Tractor and Implement Rim Problems – H. J. LAFAYE, Goodyear Tire & Rubber Co.

The Design, Production, Factory Handling and Transportation of Tractor and Implement Wheels – J. H. PLOEHN, French & Hecht, Inc.

Evening B. F. JONES, *Chairman*
A. T. COLWELL, *Sponsor*

Rubber Industry Dinner – sponsored by Akron's rubber manufacturers.

Welding Session – sponsored by the Cleveland Section.

Friday, Sept. 17

9:30 A.M. E. F. BRUNNER *Chairman*

Tire Testing Demonstration at Goodyear Zeppelin Dock.

2:00 P.M. A. W. LAVERS *Chairman*

A New Method for Testing Tractor Tires – M. K. JESSUP and A. W. BULL, U. S. Rubber Products, Inc.

Results of Tractor Tire Test Program – R. P. GAYLORD, Goodyear Tire & Rubber Co.

National Regional

FUELS & LUBRICANTS MEETING

Tulsa, Okla. *Sept. 30 to Oct. 1*

Hotel Mayo

Sponsored by the SAE Fuels and Lubricants Activity

Thursday, Sept. 30

9:30 A.M.

The Development of the Diesel Around Oil Country Problems – C. L. CUMMINS, Cummins Engine Co.

Economic Place of Automotive Oil Engines – A. F. CAMPBELL, Waukesha Motor Co.

2:30 P.M.

Oil Field Operations – A. W. S. HERRINGTON, Marmon-Herrington Co.

Evolution of Bus Maintenance Practice – FLOYD PATRAS, Southwestern Greyhound Lines, Inc.

6:30 P.M. **Banquet**

SAE Activities – John A. C. WARNER, SAE secretary and general manager.

Friday, Oct. 1

9:30 A.M.

Gasoline Volatility – H. M. TRIMBLE and R. C. ALDEN, Phillips Petroleum Co.

Essentials of Fuel Utilization in Diesel Engines of the Automotive Type – ROBERT D. BEST, Continental Oil Co.

2:30 P.M.

Engine Cooling Problems – F. M. YOUNG, Young Radiator Co.

Bringing the Private Owner Airplane Up to Date – MAC SHORT, Los Angeles.

6:30 P.M. **Dinner**

Student Meeting – Debate

Diesel Engine Vs. Gasoline Engine for Automotive Applications – UNIVERSITY OF OKLAHOMA VS. TULSA UNIVERSITY.

1937 S·A·E SECTION OFFICERS 1938

• Baltimore

Chairman: E. W. Jahn, superintendent, transportation, Consolidated Gas, Electric Light & Power Co.; vice-chairman: L. W. Shank, division manager, Ethyl Gasoline Corp.; treasurer: Robert C. Hall, mechanical engineer, Baltimore Transit Co.; secretary: Edward Stead, chief engineer, Koppers Co.

• Buffalo

Chairman: Raymond P. Johnson, supervisor of distribution, Socony-Vacuum Oil Co., Inc.; vice-chairman: O. Arnold Hansen, automotive engineer, Linde Air Products Co.; secretary-treasurer: George W. Miller, vice-president, charge production, Technical Division, American Lubricants, Inc.

• Canadian

Chairman: William E. McGraw, chief engineer, Chrysler Corp. of Canada, Ltd.; vice-chairman: Charles E. Tilston, assistant to manager, Lubrication Department, Imperial Oil Co., Ltd.; treasurer: Marcus L. Brown, Jr., factory manager, Seiberling Rubber Co. of Canada, Ltd.; secretary: Warren B. Hastings, editor and manager, *Canadian Motorist*.

• Chicago

Chairman: Harry F. Bryan, carburetor engineer, International Harvester Co.; vice-chairman: D. Edwin Gamble, vice-president, general manager, Borg & Beck Division, Borg Warner Corp.; treasurer: Harry O. Mathews, automotive engineer, Public Utilities Engineering & Servicing Corp.; secretary: Edward A. Sipp, assistant to president, manager, sales, Burgess Battery Co.

• Cleveland

Chairman: B. Frank Jones, chief engineer, Indiana Division, White Motor Co.; vice-chairman: John E. Hacker, production manager, Winton Engine Mfg. Corp.; vice-chairman for Akron and Canton districts: Walter E. Shively, manager, tire design, Goodyear Tire & Rubber Co.; treasurer: Arthur Townhill, experimental engineer, Thompson Products, Inc.; secretary: Arthur O. Willey, consulting engineer, Lubri-Zol Corp.

• Detroit

Chairman: Floyd F. Kishline, chief engineer, Graham-Paige Motors, Inc.; vice-chairman, representing Aeronautic Activity: William F. Gerhardt, professor, aeronautic engineering, Wayne University; vice-chairman, representing Body Activity: I. L. Carron, body engineering department, Chrysler Corp.; vice-chairman, representing Passenger Car Activity: George A. DeLaney, electrical engineer, Pontiac Motor Co.; vice-chairman, representing Production Activity: Joseph Geschelin, Detroit technical editor, Chilton Publications; vice-chairman, representing Student Activity: Albert C. Hazard, engineer, Chevrolet Motor Co.; treasurer: F. W. Marschner, western sales manager, New Departure Mfg. Co.; secretary: R. N. Janeway, research engineer, Chrysler Motor Corp.

• Indiana

Chairman: Robert M. Critchfield, chief engineer, Delco-Remy Corp.; vice-chairman: Macy O. Teetor, charge research engineering, Perfect Circle Co.; vice-chairman: Albert L. McColloum, sales manager, National Malleable & Steel Castings Co.; vice-chairman (ex-officio): Charles C. Merz, manager, Merz Engineering Co.; treasurer: Robert C. Wallace, assistant chief engineer, Marmon-Herrington Co., Inc.; secretary: Harlow Hyde, Indianapolis.

• Kansas City

Chairman: Earl W. Pughe, plant manager, Chevrolet Motor Co.; vice-chairman: Charles W. McAllister, lubrication engineer, Sinclair Refining Co.; secretary-treasurer: Harold W. Vetter, chief inspector, Chevrolet Motor Co.

• Metropolitan

Chairman: S. G. Tilden, president, treasurer, S. G. Tilden, Inc.; vice-chairman: Harold F. Blanchard, technical editor, *Motor Magazine;* vice-chairman for Aeronautics: R. F. Gagg, assistant chief engineer, Wright Aeronautical Corp.; vice-chairman for Diesel Engines: W. J. Cumming, general superintendent, Surface Transportation Corp.; vice-chairman for Fuels and Lubricants: Maurice Walter, chief engineer, Walter Motor Truck Co.; vice-chairman for Passenger Car and Body: R. M. Creager, engineer, transportation, Public Service Electric & Gas Co.; vice-chairman for Student Activities: H. S. Cameron, instructor, mechanical technology, Pratt Institute; vice-chairman for Transportation and Maintenance: T. L. Preble, supervisor, automotive transportation, Tide Water Associated Oil Co.; treasurer: John J. Powelson, assistant to manager, motor-vehicle department, Standard Oil Co. of N. J.; secretary: M. C. Horine, sales promotion manager, Mack Mfg. Corp.

• Milwaukee

Chairman: George W. Curtis, district manager, Timken Roller Bearing Co.; vice-chairman: John J. Hilt, vice-president, Young Radiator Co.; treasurer: Robert M. Schaefer, assistant to president, Twin Disc Clutch Co.; secretary: Walter F. Strehlow, engineer, Tractor Division, Allis-Chalmers Mfg. Co.

• New England

Chairman: John H. Walsh, superintendent, rolling stock and shops, Middlesex & Boston Street Railway Co.; vice-chairman: George A. Downey, assistant manager, George Lawrence, Inc.; treasurer: Albert Lodge, district agent, Goodrich Oil Products Co., Inc.; secretary: John W. Lane, automotive engineer, Socony-Vacuum Oil Co., Inc.

• Northern California

Chairman: Al. Harry Lau Fer, Marvel Carburetor Sales Co.; vice-chairman: George L. Neely, research engineer, lubrication specialist, Standard Oil Co. of Calif.; treasurer: Ulysses A. Patchett, assistant professor, Stanford University; secretary: W. S. Crowell, San Francisco.

• Northwest

Chairman: W. W. Churchill, superintendent of equipment, Washington Motorcoach Co.; vice-chairman: Harley W. Drake, superintendent of equipment, Pacific Highway Transport; treasurer: Ralph P. Denison, foreman auto repairs, City of Seattle, Lighting Department; secretary: John C. Clendenen, salesman, Standard Oil Co. of Calif.

• Oregon

Chairman: Joseph P. Seghers, president, manager, Seghers Motors Co.; vice-chairman: Fred Dundee, manager, Dundee Auto Repairs & Machine Works; treasurer: Kenneth H. Mutch, service manager, Wentworth & Irwin, Inc.; secretary, Herbert Zenger, manager, George Faulkner Co.

• Philadelphia

Chairman: F. L. Creager, superintendent, engineering, Model Shop, RCA Mfg. Co.; vice-chairman: F. C. Hubley, general service manager, Autocar Co.; treasurer: William Schwarz, Jr., district service manager, White Motor Co.; secretary: Henry Jennings, technical editor, *Commercial Car Journal.*

• Pittsburgh

Chairman: Ralph Baggaley, Jr., superintendent of equipment, McCrady-Rodgers Co.; vice-chairman: R. M. Welker, Gulf Oil Corp.; treasurer: Charles R. Lund, lubrication engineer, American Oil Co.; secretary: George W. Brisbin, superintendent automotive and safety, Peoples & Columbia Natural Gas Companies.

• St. Louis

Chairman: J. E. Jury, manager, technical service, Shell Petroleum Corp.; vice-chairman: John Cox, Wagner Electric Corp.; treasurer: R. J. Greenshields, Jr., engineer, Motor Test Laboratory, Shell Petroleum Corp.; secretary: Dwight M. Gordon, experimental engineer, Carter Carburetor Corp.

• Southern New England

Chairman: Herbert W. Best, assistant professor, Yale University, School of Engineering; vice-chairman: E. R. Carter, vice-president, charge of engineering, Fafnir Bearing Co.; vice-chairman for Aeronautics: Rex B. Beisel, chief engineer, Chance Vought Aircraft Div., United Aircraft Mfg. Corp.; treasurer: T. C. Delaval-Crow, chief engineer, New Departure Mfg. Co.; secretary: Chester R. Wells, design engineer, United Aircraft Corp., Pratt & Whitney Engine Division.

• Syracuse

Chairman: Edward S. Marks, Doman-Marks Engine Co.; vice-chairman: Carl T. Doman, Doman-Marks Engine Co.; treasurer: William G. Hawley, Syracuse; secretary: Richard F. Russell, American La France & Foamite Corp.

• Washington

Chairman: W. F. Beasley, automotive engineer, U. S. Army, Ordnance Department; vice-chairman: E. B. English, manager, Washington Office, Caterpillar Tractor Co.; treasurer: C. S. Bruce, assistant mechanical engineer, National Bureau of Standards; secretary: Charles Hiller, Jr., associate automotive engineer, War Dept., Automotive Section Artillery Division, Ordnance Office.

About SAE Members: ....*At Home and Abroad*

(*Continued from page 20*)

Alfred Reeves, vice-president of the Automobile Manufacturers Association, predicts that American exports of cars and trucks will exceed 600,000 this year, basing his forecast upon observations made during his recent trip to European automotive centers. Mr. Reeves also noted that the automobile manufacturers in Europe have been enjoying the same kind of record business that car makers in the United States have had during the past six months.

Yoshio Ogawa, who has been practicing as consulting engineer in Los Angeles, sailed for Japan early in August to accept a new position.

Max H. Schachner has been named assistant sales manager of the Winton Engine Corp. He was formerly supervisor of engine sales, Caterpillar Tractor Co., Peoria, Ill., and prior to that was connected with Continental Motors.

Max H. Schachner
Joins Winton

E. L. Cord has resigned as chairman of the Cord Corp. He has sold his entire holdings in the corporation to a group of New York bankers and is reported to have received a total of $2,632,000 in the transaction.

David W. Grimes is head of the experimental engineering department, John Bean Manufacturing Co., Lansing, Mich.

George Mezey has joined the Pontiac Motor Division of General Motors as service representative for the state of Florida. He will make his headquarters at Orlando.

Frederick E. King, formerly a student at the University of Michigan, has joined Prest-O-Lite Co., Inc., Indianapolis, as acetylene research engineer.

Charles F. Kettering, vice-president of General Motors in charge of research, predicted 37,000,000 motor-vehicles by 1960 in a talk before the American Society of Civil Engineers at its 67th annual convention, July 21.

A. H. Packer, editor, *Motor Service Magazine,* is author of the book, "Electrical Trouble Shooting," of which a revised edition has recently been published.

Ferris L. McRay, a former member of the SAE Student Branch at Oregon State College, has joined the Allis-Chalmers Manufacturing Co., Milwaukee, as student engineer, tractor division.

John A. Kany, formerly a member of the SAE Student Branch at Purdue University, has joined the Reo Motor Car Co. During his training period he will be transferred from one department to another.

A. J. Langhammer
Named President

A. J. Langhammer has been made president of the Amplex Division of Chrysler Corp. He was previously in charge of manufacturing and sales, Bearing Division of Chrysler.

T. P. Samuels has joined the oil sales department of the Crane Co., Chicago, Ill. He will sell to refineries.

Charles K. Edward has been made purchasing agent for Dallas E. Winslow, Inc. He will be located in Detroit. Mr. Edward was formerly manager, Dallas E. Winslow of Canada, Ltd.

Charles H. Jackson is chief of test equipment construction, International Radio Corp., Ann Arbor, Mich. Before taking this position he was a student at the University of Michigan.

Alfred R. Code has been advanced from automotive engineer to chief engineer, technical department, by Vacuum Oil Co., Pty., Ltd., Melbourne, Australia.

C. A. Spinola has been appointed instructor in the high school at Hilo, Hawaii, by the Department of Public Education, Territory of Hawaii. He was formerly a student at the Polytechnic College of Engineering, Oakland, Calif.

Herbert Clark
Takes New Post

Herbert Clark, former managing director of Tangyes, Ltd., Birmingham, England, has become associated with Nuffield Mechanizations, Ltd., also in Birmingham, as deputy managing director.

E. R. Birchard recently was appointed regional manager, General Motors Products of Canada, Ltd., with headquarters at Regina. Prior to this appointment Mr. Birchard, who has been with G.M.C. for 17 years, was assistant general sales manager of the company, located at Oshawa.

Research Committee Changes

At its July 16 meeting the SAE Council approved the following Research Committee changes: Robert V. Kerley to replace Capt. F. D. Klein on the Crankcase Oil Oiliness Research Committee, the Crankcase Oil Stability Research Committee and the Fuels Research Committee; W. M. Holaday to replace C. H. Schlesman on the Crankcase Oil Oiliness Research Committee and the Fuels Research Committee; J. H. Krestan to replace A. R. Lange as representative for the Swan-Finch Oil Corp. on the Extreme-Pressure Lubricants Research Committee; Carl Beaver to replace Earl Bartholomew on the Ignition Research Committee.

E. L. Allen has been appointed chief engineer of the Auburn Automobile Co., Connersville, Ind. He was previously Auburn's chief body engineer. Mr. Allen has been affiliated with the automobile industry since 1920; with Auburn since 1928.

Samuel Untermyer, 2nd, who has been with Sinclair Refining Co., East Chicago, Ind., as fuel tester, has joined the Hercules Motors Co., Canton, Ohio.

L. G. Kreiser, until recently a student at Purdue University, has joined the AC Spark Plug Division of G.M.C., Flint, Mich., as student engineer.

Dr. Gustav Egloff, director of research, Universal Oil Products Co., delivered the first branch lecture of the Institution of Petroleum Technologists at the Royal Society of Arts, London, June 8. His subject was "Synthesis in the Oil Industry." The lecture was also delivered to the South Wales branch, June 9, and to the northern branch at Manchester, June 11. On June 8, Dr. Egloff also addressed the Oil Industries Club on "Polymer Fuels." At the World Petroleum Congress, held in Paris, June 14-19, Dr. Egloff presented a paper of which he was co-author with *W. H. Hubner* and G. B. Murphy, also of Universal Oil Products Co. Titled "Aircraft Fuel Specifications – Present and Future," it is published in the July 28 issue of *National Petroleum News.*

Frank E. Phillips, export manager, Gemmer Manufacturing Co., Detroit, is visiting European automobile centers. He expects to return early this month.

Thomas Midgley, Jr., vice-president, Ethyl Gasoline Corp., will be chairman of a symposium on characteristic properties of hydrocarbons at the 94th meeting of the American Chemical Society, Rochester, Sept. 6-10. *Dr. Gustav Egloff,* of the Universal Oil Products Co., and Dr. J. C. Morrell, of the same company, are authors of a paper on "Petroleum as Source Material for Chemical Derivatives," to be given at another session of the meeting.

H. C. Mougey, chief chemist and assistant technical director, General Motors Corp., has been nominated to the executive committee of the American Society for Testing Materials.

Charles W. Gadd is research assistant with General Motors Research Laboratories. He was previously a student at Massachusetts Institute of Technology.

Paul D. Hileman has been appointed general manager of the Jadson Motor Products Co., Bell, Calif., a subsidiary of Thompson Products, Inc. Mr. Hileman, who has been active in the Detroit Section, has been Detroit representative for the parent organization for the last nine years.

Paul D. Hileman
To California

Edward C. Hoenicke has been elected vice-president and a member of the board of directors of the Eaton-Erb Foundry Co., Detroit. Prior to this promotion Mr. Hoenicke was the company's sales manager.

Chien Kao has joined the staff of General Motors Truck Co., Pontiac, Mich., as tool designer.

Howard H. Heffley is taking the engineering training course of the Cooper-Bessemer Corp., Grove City, Pa. He was formerly chairman of the SAE Student Branch at Ohio State University.

Howard H. Heffley
Training

D. L. Berry, a former student at Ohio State University, has joined the Shell Petroleum Co., as junior mechanical engineer, motor laboratory, St. Louis, Mo.

J. H. Hunt Re-Elected President of E.S.D.

John H. Hunt, director, new devices section, General Motors Corp., has been elected to serve a second term as president of the Engineering Society of Detroit. Clyde R. Paton, chief engineer, Packard Motor Car Co., and Glenn Coley, metallurgist, Detroit Edison Co., have been elected treasurer and assistant treasurer, respectively. These three SAE members are also serving their second year as directors of the E.S.D.

R. N. Janeway, research engineer, Chrysler Corp., has been elected vice-chairman of the Affiliate Council of E.S.D.

C. L. Eksergian, chief engineer, Budd Wheel Co., has been named chairman of the American Welding Society's newly formed Automotive Council. Other SAE members serving on this council are: *W. H. Graves,* chief metallurgist, Packard Motor Car Co.; *John H. Hunt,* director, new devices section, General Motors Corp.; *H. M. Northrup,* chief engineer, Hudson Motor Car Co.; and *David Wallace,* president, Chrysler Division of Chrysler Corp.

George J. Mead, vice-president and chief engineer of United Aircraft Corp., recently received an honorary degree of Doctor of Science from Trinity College in recognition of his outstanding contributions to the science of aeronautics.

Edward C. Yokel is draftsman for the Twin Disc Clutch Co., Racine, Wis. He formerly attended Purdue University.

Max Hofmann has been appointed export sales manager of the Waukesha Motor Co., Waukesha, Wis. He has been a member of the Waukesha engineering staff since 1926, when he came to that company from the Argentine branch of Korting Brothers, German Diesel engine manufacturers. Last year he was SAE JOURNAL field editor for the Milwaukee Section.

Logan Roark, a former student at the University of Oklahoma, has joined the engineering staff of the Stearman Aircraft Co., Wichita, Kan.

S. E. Dithmer, sales manager, General Motors Japan, Ltd., and a member of the SAE Overseas Relations Committee, left his headquarters in Osaka, Japan, on July 19 for a visit to this country. He expects to return early in December.

Hubert N. Harmon, a recent graduate from Purdue University, is junior aeronautical engineer with the National Advisory Committee for Aeronautics at Langley Field, Va.

Changes at Caterpillar

Three SAE men have been transferred to new positions by the Caterpillar Tractor Co. Paul Weeks, for two years manager of the engine sales division at Peoria, again takes charge of the Washington, D. C., office which he had previously managed. E. B. English, formerly manager of the Washington office, has been made manager of Federal and state sales, with headquarters at Peoria, succeeding H. H. Howard, recently appointed manager of the engine sales division at Peoria.

Obituaries

G. A. Schreiber

G. A. Schreiber, Detroit consulting engineer, died Aug. 16 as the result of injuries received when he was struck by an automobile July 21. He had been a member of the SAE since 1911, joining the Society shortly after coming to this country from Germany, the land of his birth. He was born in Saxony in 1881 and had five years of training in German technical schools. Later he attended Queen's University at Kingston, Ontario.

From 1903 to 1906 he held positions with the Adler and Daimler companies in Germany and the Spyker works in Holland. He had previously worked at the Krupp plants and the Ludwig Loewe Co. in Germany.

During his early years in this country he wrote for technical papers here and in Germany, was with the old E.M.F. Co. and from 1910-1914 handled sales for E.M.F. and the Paige Motor Car Co. in Europe. He was production engineer for Willys-Overland in the early '20s and later was associated with General Motors Truck and White. He established his practice as consultant in 1926. Mr. Schreiber was a familiar figure at SAE meetings.

Joseph C. Halbleib

Joseph C. Halbleib, a member of the Society since 1911, died on Aug. 16, following an emergency operation. He was 58 years old.

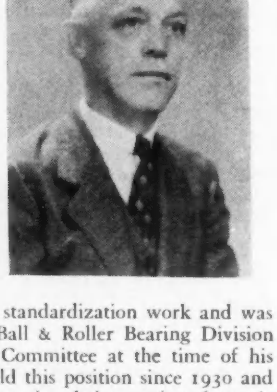
Mr. Halbleib was sales manager of the Delco Appliance Corp., Rochester, N. Y., formerly the North East Electric Co., which he helped found with his brother, Edward A. Halbleib, an SAE member. Until the company was purchased by General Motors in 1929, Mr. Halbleib was a director. The two Halbleib brothers developed the electric starter-generator manufactured by the company.

He was also active in the founding of the Electromatic Typewriter Co., now a division of International Business Machine Corp., and was vice-president of the Rochester Brewing Co.

George Robert Bott

George Robert Bott, chief engineer and a director of the Norma-Hoffmann Bearings Corp., Stamford, Conn., died Aug. 14 following a heart attack at his summer home near New Canaan, Conn. Mr. Bott, who had been a member of the Society since 1914, was particularly interested in SAE standardization work and was chairman of the Ball & Roller Bearing Division of the Standards Committee at the time of his death. He had held this position since 1930 and had previously been vice-chairman (1926-1929). He first became active in this work in 1917.

George R. Bott



Mr. Bott, a pioneer in the anti-friction bearing industry and holder of several patents, joined the Norma-Hoffmann Corp. about 25 years ago. He had previously engaged in consulting work and earlier had held important engineering positions in automotive and other industries.

He was born at Burlington, Iowa, in 1879. In 1901 he received his M.E. degree from Ohio State University and returned there in 1906 to serve three years as a member of the faculty.

C. C. McConville

C. C. McConville, superintendent of the Clintonville factory of the Four Wheel Drive Auto Co., died suddenly on Aug. 10 following a heart attack which occurred in the FWD factory. He was 63 years old and had been a member of the Society since 1918. Funeral services were held Aug. 12 in the showroom of the factory in which he had worked for 21 years.

Mr. McConville graduated from the University of Wisconsin in the class of '98, and in the following year coached Wisconsin's famous "berry crate" crew. In 1900 he became superintendent of factories for the Emerson Brandiham Co., and later held a similar position with the Big Four Tractor Co. of Minneapolis. He was appointed superintendent of the FWD factory in 1916 and in that capacity directed production of thousands of trucks during the World War.

Merton A. Dunnigan

Merton A. Dunnigan, manager, operating department, W. H. Barber Co., Minneapolis, died recently. He had been affiliated with the oil industry since 1916 when he was graduated from the University of Michigan with degrees of Bachelor of Arts and Bachelor of Science in chemistry. Mr. Dunnigan was chemist and engineer with the Pure Oil Co., manager of the Western Oil Co., Ltd., of Canada, and manager of lubrication department, White Eagle Oil & Refining Co., before joining the W. H. Barber Co. as engineer in 1926. He was made manager of the operating department in 1930, the year after joining the SAE. He was 42 years old and a native of Michigan.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between July 15, 1937, and August 15, 1937.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

AMBROSE, HENRY A. (M) research chemist, Gulf Research & Development Co., P. O. Drawer 2038, Pittsburgh, Pa.

BABLER, WATT E. (A) chief, automotive division, American Steel Foundries, Indiana Harbor Works, East Chicago, Ind.; (mail) 2508 E. Beverly Rd., Milwaukee, Wis.

BALMER, RICHARD C. (J) draftsman, Yellow Truck & Coach Mfg. Co., Pontiac, Mich.;(mail) 234 Liberty St.

BERNA, TELL (A) general manager, National Machine Tool Builders' Assn., 10525 Carnegie Ave., Cleveland, Ohio.

BOURQUE, A. V. (A) secretary, treasurer, Western Petroleum Refiners Assn., 607 Cosden Bldg., Tulsa, Okla.

BOWER, JOE HARRY (J) student engineer, Buick Motor Co., Flint, Mich.; (mail) 1540 N. Saginaw.

BRACH, ERNEST J. W. (J) draftsman, Busch-Sulzer Bros. Diesel Engine Co., Second and Utah Sts., St. Louis, Mo.; (mail) 2631 Louisiana Ave.

BROWN, LESTER (J) instructor, auto mechanics, Board of Education, McKinley High School, Canton, Ohio; (mail) 415 N. Main St., North Canton, Ohio.

BRUCE, JAMES G. (M) technical editor, MacLean Publishing Co., Ltd., Toronto, Ont., Canada; (mail) 481 University Ave.

BRYANT, DON H. (A) special representative, Western Automatic Machine Screw Co., Elyria, Ohio; (mail) 541 Engineers Bldg., Cleveland, Ohio.

CANDY, JAMES BENTLEY (A) lubrication engineer, D-A Lubricant Co., Inc., Indianapolis, Ind.

CORNWELL, BURR IRWIN (A) vehicular superintendent, Hall Baking Co., Div. of Continental Baking Co., 86 Joy St., Somerville, Mass.; (mail) R.F.D. No. 1, Rockland, Mass.

COURTNEY, JOSEPH F. (A) president, Underwriters Safety Device Corp.; West Town Auto Body & Service, Inc., 4640 W. Washington Blvd., Chicago, Ill.

DAVEY, PAUL H. (M) president, Davey Compressor Co., Inc., 266 N. Water St., Kent, Ohio.

DAVIDS, WILLIAM C. (S M) supervisor, marine engineer, U. S. Navy, Bldg. 5, Navy Yard, Brooklyn, N. Y.; (mail) 138 Union Ave., Rutherford, N. J.

DAVIS, ROY H. (M) president, general manager, Canadian Atlas Steels, Ltd., E. Main St., Welland, Ont., Canada.

D'ESPOSITO, JAMES F., SGT. (A) Motor Sergeant, U. S. Army, Service Battery, 104th Field Artillery, 168th St. & 93rd Ave., Jamaica, L. I., N. Y.

EDWARDS, W. C. (M) assistant chief engineer, Delco Remy Div. of General Motors Corp., Anderson, Ind.; (mail) 733 W. Seventh St.

FAGEOL, ROBLEY D. (A) president, Leibing Automotive Devices, Inc., Detroit, Mich.; (mail) 5725 Mt. Elliott Ave.

FEILER, CLIFFORD R. (J) junior designing engineer, Busch-Sulzer Bros. Diesel Engine Co., 3300 S. Second St., St. Louis, Mo.; (mail) 1946 E. Warne Ave.

FERRIE, JAMES ANDREW (A) wholesale salesman, Shell Oil Co., 1008 W. Sixth St., Los Angeles, Calif.; (mail) 1109 S. Oakhurst.

FICKEN, GEORGE V. (J) junior engineer, Socony-Vacuum Oil Co., Inc., 26 Broadway, New York City.

FORTNEY, WALTER S. (J) superintendent, Power Prover Dept., Cities Service Oil Co., Box 1748, Fort Worth, Texas.

FROMM, JOSEPH (A) service mechanic, service and maintenance of motor equipment, Pure Oil Co., 10th & Blueball Ave., Marcus Hook, Pa.

FROST, HOWARD A. (J) assistant engineering manager, Hastings Mfg. Co., Hastings, Mich.

GIORDANO, LUIGI (A) chairman of board, Carburatore Zenith, Via Freidour 9, Torino, Italy.

GOERKE, EDWIN O. (M) chief engineer, bearing division, Bohn Aluminum & Brass Corp., Detroit, Mich.; (mail) 7031 Oakman Blvd., Dearborn, Mich.

GOLDEN, VERNON C. (A) Diesel engine supervisor, Atchison, Topeka & Santa Fe Rwy. Co., 17th & Wentworth, Chicago, Ill.; (mail) 7655 S. Sangamon St.

GRUENEWALD, VAL F. (M) superintendent, motor transportation, Southeastern Div., Pure Oil Co., 140 Spring St., S. W., Atlanta, Ga.; (mail) 430 E. Ponce de Leon, Decatur, Ga.

HADLEY, WALTER C. (J) automotive engineer, Socony-Vacuum Oil Co., 412 Greenpoint Ave., Brooklyn, N. Y.; (mail) 4 Willow Ave., Larchmont, N. Y.

HEINE, WILLIAM A. (J) research associate, National Bureau of Standards, Washington, D. C.; (mail) 6501 Third St., N. W.

HERR, CHARLES H. (J) draftsman, Busch-Sulzer Bros. Diesel Engine Co., 3300 S. Second St., St. Louis, Mo.; (mail) 5222 Devonshire Ave.

HERZFELD, EUGENE (J) consulting engineer, Combustion Engrg. Corp., 200 Madison Ave., New York City.

HILL, HOWARD (J) mechanic, Mendenhall Motor Co., 2315 Locust, St. Louis, Mo.; (mail) 310 Melville, University City.

HOLZWASSER, ALBERT S. (A) treasurer, Arrow Armatures Co., 1111 Commonwealth Ave., Boston, Mass.

HUBBARD, JOHN C. (J) assistant transportation superintendent, Kraft-Phenix Cheese Corp., 400 Rush St., Chicago, Ill.

IRISH, GEORGE H. (A) transportation supervisor, Tennessee Valley Authority, Knoxville, Tenn.; (mail) 1131 Luttrell St.

JESSUP, HARLAN R. (A) sales engineer, National Supply Co. of Delaware, Superior Engine Div., Holmesburg, Philadelphia, Pa.; (mail) 241 Haverford Ave., Swarthmore, Pa.

KARL, WILLIAM CLEMENT (J) Diesel test engineer, Continental Motors Corp., 12801 E. Jefferson Av., Detroit, Mich.; (mail) 979 Lakepointe Ave., Grosse Pointe Park, Mich.

KERLEY, ROBERT V. (S M) assistant mechanical engineer, chief, fuel & oil testing unit, Power Plant Branch, U. S. Army, Air Corps, Wright Field, Dayton, Ohio.

KLAS, HAROLD W. (M) designer, Packard Motor Car Co., Detroit, Mich.; (mail) 1754 E. Grand Blvd.

KNAPP, JAMES CLAYTON (J) special division, service dept., Hudson Motors, Tilbury, Ont., Canada.

KROPF, EMIL AUGUST ADAM (F M) aviation manager, Deutsch-Amerikanische Petroleum Gesellschaft, 21, Neuer Jungfernstieg, Hamburg, Germany.

LARKIN, R. C. (A) president, R. C. Larkin Co., 3900 S. Wabash Ave., Chicago, Ill.

LARNED, W. E. (A) first pilot, United Air Lines Transport Corp., 5936 S. Cicero Ave., Chicago, Ill.

LAWRASON, ALAN B. (A) salesman, Railway & Power Engrg. Corp., Ltd., 171 Eastern Ave., Toronto, Ont., Canada.

LETELLIER, ZENO (M) vice-president, charge of production, Pate Oil Co., 3460 W. Leeds Place, Milwaukee, Wis.

MARCO, ALEXANDER S. (A) parts & accessories manager, Chevrolet Motor Div., General Motors Sales Corp., 550 W. 56th St., New York City; (mail) 184 W. Clinton Ave., Tenafly, N. J.

MARTIN, ROBERT C. (J) drafting, design, Fairbanks, Morse & Co., 260 S. Main St., Three Rivers, Mich.

MAYER, LEO (A) president, treasurer, Henry Cole-F. C. Hersee Co., 54 Old Colony Ave., South Boston, Mass.; (mail) 8 Grant Ave., Newtown Centre, Mass.

MCDONALD, JOHN B. (A) district service manager, White Motor Co., 2401 Archer Ave., Chicago, Ill.

METROPOLITAN BODY CO. (Aff.) 430 Grand St., Bridgeport, Conn. Rep.: Carlson, William, treasurer.

MINCH, J. A. (M) president, American Enameled Magnet Wire Co., 24th St., Port Huron, Mich.; vice-president, Electric Auto-Lite, Ltd., Sarnia, Ont., Canada; (mail) c/o American Enameled Magnet Wire Co.

MINER, SHELDON (A) sales engineer, Campbell Oil Co., 2003 Madison Ave., Indianapolis, Ind.

MUNCIE, ALEX (M) superintendent, motor transportation department, Pure Oil Co., 9 Kendell, Houston, Tex.; (mail) Box 239.

OLSEN, RAYMOND CHARLES (M) Plant 2, inspector & supervisor, specifications & salvage, Chevrolet Motor Co., 69th Ave. & Foothill Blvd., Oakland, Calif.; (mail) 2318 83rd Ave.

OTAKE, SHOTARO (A) director, charge of purchase and material control, Nissan Jidosha Kaisha, Ltd., Shin Koyasu, Yokohama, Japan.

POWERS, EDWARD F. (M) engineering supervisor, National Carbon Co., Inc., Room 1308, 30 E. 42nd St., New York City.

ROBEY, P. H., 1ST LIEUT. (S M) Power Plant Branch, U. S. Army, Air Corps, Materiel Div., Wright Field, Dayton, Ohio.

ROZETT, BENJAMIN (M) automotive superintendent, United Standard Products, Inc., 2526 Wabash Ave., Chicago, Ill.

SCHMIDT, DAVID L. (J) test engineer, Cadillac Motor Car Co., Clark Ave., Detroit, Mich.; (mail) 514 W. Grand Blvd.

SINGER, FRANK N. (A) superintendent of garage, Adolf Gobel, Inc., 24 Rock St., Brooklyn, N. Y.; (mail) 301 E. 21st St., New York City.

SINGER, GEORGE K. (A) engineer, Socony-Vacuum Oil Co., 26 Broadway, New York City.

STANLIK, WILLIAM C. (A) vice-president, Franklin-Weber Motors, 6115 N. Clark St., Chicago, Ill.; (mail) 1208 Jarvis St.

STARR, ALLAN M. (M) consulting engineer, 60 Crest Road, Piedmont, Calif.

STEWART, JOHN W. (A) division superintendent, Motor Transportation Dept., Ohio Fuel Gas Co., 99 N. Front St., Columbus, Ohio; (mail) Box No. 35, Wellston, Ohio.

STREK, OTTO (A) layout man, Fisher Body Corp., Detroit, Mich.; (mail) 234 Emerson Ave.

TAYLOR, J. EDWARD (J) engine assistant, Gulf Research & Development Co., Drawer 2038, Pittsburgh, Pa.

TAYLOR, J. WILLIAM (J) designing engineer, Walker's Trailer & Tire Service, 106 N. E. Oregon St., Portland, Ore.; (mail) 3145 N. E. 46th Ave.

WALKER, CLIFFORD MERRICK (F M) chief engineer, Triumph Co., Ltd., Gloria Wks., Holbrook Lane, Coventry, England; (mail) Old Hall Farm, Meriden, Warwickshire, England.

WALLS, FRED J. (M) development & research metallurgist, International Nickel Co., 67 Wall

St., New York City; (mail) 10-227 General Motors Bldg., Detroit, Mich.

WENDT, LELAND A. (J) research engineer, Shell Petroleum Corp., Wood River, Ill.; (mail) 5239 Alcott Ave., St. Louis, Mo.

WHITE, S. BALLARD, JR. (A) part owner, manager, E. H. White Co., Room 803, 550 Montgomery St., San Francisco, Calif.

WIEGAND, FRANCIS JOSEPH (J) test engineer, Wright Aeronautical Corp., Paterson, N. J.; (mail) 43 Vreeland Ave., Midland Park, N. J.

WOLFSON, MILTON A. (A) sales manager, body & service division, Maremont Automotive Products, Inc., 1625 S. Ashland Ave., Chicago, Ill.

YARNELL, HAROLD ARTHUR (A) experimental drafting, DeVilbiss Co., Toledo, Ohio; (mail) Apt. 103, Belcrest Manor, 151 Islington St.

Applications Received

The applications for membership received between July 15, 1937, and August 15, 1937, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

ADAMS, PARKER J., JR., service superintendent, Les Vogel Chevrolet Co., San Francisco, Calif.

ARCHIBALD, FRANK ROGERS, technical service supervisor, National Carbon Co. Inc., New York City.

BADLEY, JOY E., president, engineer, Angleworm Tractor Co. Ltd., Portland, Ore.

BARBOSA, P. C., manager, lubricating department, Standard Oil Co. of Brazil, Rio de Janeiro, Brazil.

BILTON, PERCY, managing director, Vigzol Oil Refining Co. Ltd., London, England.

BOHLE, FRED, mechanical engineer, Illinois Tool Works, Chicago, Ill.

CIPRIANI, CHESTER, junior engineer, Electric Auto Lite Co., Toledo, Ohio.

COLTMAN, JOHN LOUIS, draftsman, Nasmyth, Wilson & Co. Ltd., Patricroft, Manchester, England.

CRANDALL, MORRIS N., manager, Wabash Valley Service Co., Grayville, Ill.

DICK, HAROLD G., aeronautical engineer, Goodyear Zeppelin Corp., Friedrichshafen, Germany.

DYCKHOFF, OTTO, General Motors Corp., Russelsheim, Germany.

ENRIGHT, EUGENE M., district auto inspector, Socony-Vacuum Oil Co. Inc., Schenectady, N. Y.

FAWCETT, L. I., owner, Auto Electric Co., Ponca City, Okla.

GOMBOS, JOHN E., chief engineer, Duplex Motor Development Corp., Elizabeth, N. J.

GRIFFIN, EDMUND FRANCIS, The Laidlaw Co., Inc., New York City.

GUNDRY, DAVID LEE, research assistant, White Motor Co., Cleveland, Ohio.

HANNING, JAMES R., sales engineer, Canadian National Carbon Co., Ltd., Toronto, Ont., Can.

HARVEY, H. B., president, Harvey Metal Corp., Chicago, Ill.

HATTORI, RAI, service manager, General Motors Japan Ltd., Osaka, Japan.

HEDSTROM, GUSTAV, layout, draftsman, Nash-Kelvinator Corp., Nash Motors Division, Kenosha, Wis.

HEINLEIN, FRED, superintendent transportation, Cincinnati Gas & Electric Co., Cincinnati, Ohio.

HENDRY, JAMES MURRAY, service engineer, Chrysler Motors Ltd., Kew Gardens, Surrey, England.

HUESTED, RICHARD SALISBURY, service engineer, Wright Aeronautical Corp., Paterson, N. J.

JENKS, GLEN F., COL., chief of technical staff, Ordnance Dept., U. S. Army, Washington, D. C.

JUDGE, JAMES BERNARD, engineer of motor transport, U. S. Army, Denver, Colo.

KRITSER, SHELBY MASTERSON, apprentice engineer, Pan American Airways, Port Washington, N. Y.

NELSON, JACK A., automotive engineer, Standard Oil Co. of Indiana, Des Moines, Iowa.

NEWMAN, FORREST L., president and general manager, Crusader Aircraft Corp., Denver, Colo.

NICOL, WILLIAM FRANKLIN, draftsman, Braniff Airways, Inc., Dallas, Texas.

SCOTT, E. E., superintendent of motor equipment, City of Oklahoma, Municipal Garage, Oklahoma City, Okla.

SHAW, W. WILBUR, consulting racing engineer, Merz Engineering Co., Indianapolis, Ind.

SLEEPER, ARNOLD Z., sales engineer, National Carbon Co., Chicago, Ill.

SPEISER, WILLIAM ZIMMERMEN, inspector, Wright Aeronautical Corp., Paterson, N. J.

THOME, JOHN MACON, draftsman, Caterpillar Tractor Co., Peoria, Ill.

THOMPSON, GEORGE LAWRENCE, foreman, Nicholl's Garage, Taihape, N. I., New Zealand.

TIGHE, WILLIAM ROLLINS, lubrication assistant, Standard Oil Co. of N. J., Baltimore, Md.

National Aircraft Production Meeting

(Continued from page 21)

These men will present nine of the meeting's 16 papers. Their topics will be fitted into sessions on Engine Performance, Engine Operation and Maintenance, Production, Aircraft Materials, Aircraft Processes, Factory Equipment and Operation and Maintenance.

The Aviation Banquet and Ball will climax the meeting, affording relaxation after three days of fast-moving technical sessions. A high spot will be the award of the Wright Brothers Medal for the best paper on aerodynamics or structural theory or research, or airplane design or construction presented before the Society in 1936.

The airlines remind us that Los Angeles is only overnight from just about anywhere in the United States. The new Diesel-electric trains can get you there in a hurry, too.

Don't miss the 1937 SAE National Aircraft Production Meeting – the only national forum devoted to aircraft production problems!

SAE *Coming* EVENTS

Cleveland Section Regional Tractor Meeting

Sept. 15-17 Akron, Ohio
Mayflower Hotel

Chicago Section Regional Transportation Meeting

Sept. 29-Oct. 1 Chicago
Blackstone Hotel

Fuels and Lubricants Regional Meeting

Sept. 30 & Oct. 1 Tulsa, Okla.
Mayo Hotel

National Aircraft Production Meeting

Oct. 7-9 Los Angeles
Ambassador Hotel

Annual Dinner

Oct. 28 New York
Commodore Hotel

National Production Meeting

Dec. 8-10 Flint, Mich.
Hotel Durant

Annual Meeting

January, 1938 Detroit

Detroit—Sept. 27

Edison Institute, Greenfield Village, Dearborn; dinner 6:30 P.M. Dearborn Inn. Development of Materials will be the subject of three papers. There will also be an exhibit of old cars dating from 1863 to the present time, in addition to an exhibit of old and new parts. Meeting open to S.A.E. members only.

Metropolitan—Sept. 14

Pelham Country Club, Pelham Manor, N. Y. Golf, bridge and swimming in the afternoon; dinner and dancing in the evening. Members of nearby Sections invited.

Northern California—Sept. 14

Engineers Club, San Francisco, Calif.

S. A. E. Papers in Digest

HERE are digests of papers presented at various meetings of the Society.
Some of these papers will be printed in full in the S.A.E. JOURNAL.
Mimeographed copies of *all papers received* will be available, until current supplies are exhausted, at a cost of 25 cents per copy to members; and at 50 cents per copy to non-members, plus 2% sales tax on those delivered in New York City. Orders for mimeographed copies must be accompanied by remittance and should be addressed to Sessions Secretary, Society of Automotive Engineers, 29 West 39th St., New York.

1937 Summer Meeting

White Sulphur Springs, West Va., May 4-9

Air-Cooled Aero-Motors in the Next Five Years – *A. H. R. Fedden, Bristol Aeroplane Co., Ltd.*

THE author has written an addendum to his paper, "Future Research on Air-Cooled Aero-Engines" delivered in July, 1935.

General prophecies are made on airplane performance, types, trends on the number of engines per airplane, engine sizes in airplanes, wing loading, and engine arrangement. An analysis of engine types to complete the desired power range is both interesting and sound, indicating a definite trend toward higher powers. The advantages of the use of higher octane fuels are stressed.

Mr. Fedden deplores the fact that no development work on compression-ignition aircraft engines is being done in England, and thinks that the 1500-hp. class should be tackled energetically. Advantages of fuel saving and decreased fire hazard are mentioned.

A clear picture is painted of the comparative qualities of various engine types.

Negative cooling drag is claimed to be possible at airplane speeds of 400 m.p.h. Advantages and disadvantages of two-row and single-row radial engines are discussed.

In-line engines are believed to be too heavy and expensive which is also said of the high-speed engine with a large number of small cylinders.

The flat engine is mentioned as a possibility although its use depends on the thickness of the airplane wing.

Advice from the airplane designer is considered to be needed on wing-thickness trends and other aerodynamical matters to assist in the proper selection of engine types.

Powerplant Trends – *George J. Mead, United Aircraft Corp.*

THE rapid increase in the size of our air transports, as well as the requirements for higher cruising speeds, forewarn of the need of powerplants of decidedly greater power. The further development of the existing standard types may be relied upon to ultimately provide at least 50 per cent greater output. There is, however, definite evidence now of the need of engines of even greater power in the period immediately ahead, which need has focused attention on other types in which additional displacement may be provided through the employment of a greater number of cylinders.

Studies indicate that there is an opportunity of reducing the powerplant drag sufficiently to effect a saving in fuel at least as great as is promised by further improvement in specific consumption. For this reason the form and location of the new powerplants, as well as the method chosen for cooling them, will be dictated largely by the resulting effect on operating costs. It seems likely that two new engine types will result in which twice as many cylinders may be employed as is now common practice and proportionately greater power will be provided.

The problems involved are decidedly more complex than hitherto have been encountered, but the industry is now equipped with both personnel and experience to deal effectively with them. For this reason, there is little question that powerplant development will keep pace with the requirements.

Cab-Over-Engine Trucks – Their Place in Transportation – *Pierre Schon, General Motors Corp.*

(Paper published in full, pages 421-427, Transactions Section, this issue.)

Cab-Over-Engine Trucks – Their Advance in Design – *A. M. Wolf, consulting engineer.*

DEPENDING upon the location of the front wheel, the door and step are placed either at the front or back of the cab. Some designs incorporate a protruding "hood" portion while others extend the cab fully forward. The engine compartment is either immediately back of the radiator or under the cross seat. The floor and seat heights are relatively higher than in the conventional truck, and better visibility is obtained. The engine hood is well insulated for heat and sometimes for sound as well. Most powerplants are removable readily for major repairs although, in most instances, major maintenance operations can be done readily within the cab.

Front axle treads have been increased in order to give greater stability on the road as well as to avoid an excessively large wheelhouse

The change in weight distribution has called for considerably more study on braking distribution. The shortened wheelbase requires a more accurate location of the fifth wheel in tractor-semi-trailer service; has emphasized the importance of the steering-angle conditions of the front axle; and has brought riding qualities to the fore.

Specifications and dimensional data accompany the paper as well as drawings of typical layouts showing the cab, engine, and front-axle relationships.

Maintenance of Cab-Over-Engine Trucks Vs. Conventional Trucks. – *Robert Cass, White Motor Co.*

IT is the purpose of this paper to present, as far as possible, concrete evidence of the differences that exist between the maintenance costs of the two distinct types of trucks.

It would seem, however, that there exists a wide divergence of opinion as to the two types, but a closer examination reveals that the ingenuity as displayed by the various truck manufacturers' engineering departments has offset to a very large degree what at first sight seems to be a rather difficult problem to solve.

In addition to the question of accessibility of the engine, the clutch and transmission are considered, as well as the various features of cab construction which are inseparable from a study of maintenance with the cab-over-engine type.

Wherever possible illustrations are used to bring out the various solutions to the problem of accessibility. It is pointed out that, even if the maintenance cost should be higher for this type of truck, the operating advantages under certain circumstances more than outweigh what at most must be a slight difference.

Electrical Character of the Spark Discharge of Automotive Ignition Systems – *M. F. Peters, G. F. Blackburn, and P. T. Hannen, National Bureau of Standards.*

METHODS are given for measuring current and voltage during the spark discharge in automotive ignition systems. Equations are developed which show the relation between voltage and current, and other equations are presented by means of which such quantities as frequency of the oscillations, decrement, resistance, and energy may be deduced from measurements made on an oscillogram.

The methods developed are applied to a typical ignition circuit. In the circuits used currents as high as 80 amp. at a frequency of about 6 megacycles were measured. The possibility of the occurrence of phenomena other than those recorded by the oscillograph is discussed briefly.

Radio Shielding – *Harold E. Gray, radio engineer, American Airlines, Inc.*

THE general discussion presented in this paper includes shielded ignition systems, covering both high-tension and low-tension sides of the magneto, generators and generator control boxes, radio power units, motors for general service, and a résumé of airplane shielding and bonding practices.

An Investigation of Mica Spark-Plugs – *Melville F. Peters, H. Kendall King, and John P. Boston, National Bureau of Standards.*

A SIMPLIFIED mathematical analysis of the heat flow in mica spark-plugs and in the adjacent ignition cable is given in this paper, together with curves showing various relationships of temperature and thermal conductivity. The related question of thermal expansion also is

considered. Some of the more important electrical characteristics such as capacitance, potential gradients, corona, and altitude flash-over, are discussed.

An experimental section gives a design for a mica plug and a description of experimental types with data on the more important aspects of performance. Methods of testing are discussed.

The In-Line Air-Cooled Aircraft Engine – *A. T. Gregory, Ranger Engineering Corp.*

WITH engine outputs continually going up it is worthy to note that the in-line air-cooled engine possesses certain inherent characteristics which make it particularly suitable as an aircraft engine of high output.

Satisfactory cooling of this type of engine has been obtained at higher rated specific outputs than have yet been achieved in any other kind of air-cooled engine.

A type of valve gear can be used which, in addition to being suitable for high-speed operation, permits long periods of operation without the necessity for checking valve clearances.

The lubrication of this type of engine appears to be less of a problem than that of the slower speed radials.

Smoothness of operation and relative quietness at high speed not only afford comfort to pilots and passengers, but also affect favorably the life of both engine and airplane.

The cowling of the in-line engine is relatively simple and permits excellent visibility combined with the possibility of reduced drag.

Specific weights of in-line engines compare favorably with other engines of equal horsepower. As specific outputs are increased, the in-line engine should gain a weight advantage over other types.

Altitude and Other Variables Affecting Flame Speed in the Otto-Cycle Engine – *C. L. Bouchard, C. Fayette Taylor, and E. S. Taylor, Massachusetts Institute of Technology.*

IN the investigations reported in this paper flame-trace photographs were taken on a moving film through a glass-window slot in an engine cylinder to show the effects of various operating conditions on the rate of flame travel across the combustion-chamber. The tests were made with a small L-head single-cylinder engine in the Sloan Automotive Laboratories at the Massachusetts Institute of Technology. The technique is similar to that used by Withrow and Boyd in flame studies reported in 1931.

This investigation covers a considerable range of operating conditions, including altitude, with and without supercharging, inlet temperature, humidity of the intake air, engine speed, ignition timing, and fuel-air ratio.

In general, the results show that flame speed decreases with increasing altitude in an unsupercharged engine. Either supercharging or reducing the exhaust pressure with inlet pressure constant, tends to increase flame speed. The flame speed decreases with increasing inlet temperature and with increasing humidity. Observations of the effects of revolutions per minute, fuel-air ratio, and spark-advance confirm the results of previous investigations.

Crankcase-Oil Temperature Control – *Ellis W. Templin, Department of Water and Power, Los Angeles, Calif.*

(Paper published in full, pages 325-342, Transactions Section, August issue.)

High Oiliness – Low Wear? – *G. L. Neely, research engineer, Standard Oil Co. of Calif.*

THE purpose of this paper is to call attention to the need for fundamental wear investigations and to show that wear does not correlate with oiliness.

A testing machine suitable for measuring both friction and wear is described. The machine, which is a modification of one previously reported by the author, uses two sets of frictional surfaces – one in the form of a track having two concentric rails and the other consisting of three small buttons with recessed centers and flat tracks on the outer edges. An important feature of the machine is that the rubbing surfaces are maintained automatically at an almost uniform degree of surface smoothness by the lapping action produced by the combined rotating and sliding motion of the buttons.

The results presented lead to the following conclusions within the thin-film range investigated:

(1) Both wear and friction vary directly with load.

(2) Total wear reaches a maximum, in some cases, at one particular speed, whereas wear rate (metal removed per unit of linear surface rubbed) decreases generally as speed is increased.

(3) No direct relation exists between wear and friction.

A new term, "coefficient of wear," relating wear rate and load is proposed.

No attempt is made to correlate the data obtained with other types of operation or metal combinations as data on these problems are incomplete at the present time.

High-Pressure Viscosity as an Explanation for Apparent Oiliness – *H. A. Everett, The Pennsylvania State College.*

OILS from three different crudes, matched as to initial viscosity but with widely different viscosity indexes, gave markedly different values when tested in an oiliness machine.

As viscosity index indicates temperature effects only, the effect of pressure on viscosity was investigated in a high-pressure viscometer. For each oil viscosities at pressures up to 50,000 lb. per sq. in. were obtained for three different temperatures. From these data characteristic curves were plotted giving complete pressure, viscosity, temperature (P.Z.T.) relations. Using such curves it was possible to trace the changes in viscosity which each oil underwent in its passage through the bearing and obtain an estimate for equivalent viscosity. When this study was made, the different so-called "oiliness" effects were shown to be but the normal effect of the true viscosity actually existing in the oil film.

The paper calls attention to the need for information on the influence of pressure on viscosity as well as of temperature on viscosity when comparing or predicting the performance of oils in service bearings.

Fundamentals of Vehicle Performance – *Merrill C. Horine, Mack Mfg. Corp.*

(Paper published in full, pages 13-19, August issue.)

Safety in Car Design – *J. H. Hunt, General Motors Corp.*

(Paper published in full, pages 349-357, Transactions Section, August issue.)

A Springless Bouncing-Pin Indicator – *Earl Bartholomew and Cleveland Walcutt, Ethyl Gasoline Corp.*

NOTWITHSTANDING the large variations in the relative knock ratings of fuels in cars, even under the same test conditions, the commercial importance of the maintenance of the established antiknock standards warrants any research designed to improve the reproducibility of laboratory ratings. Carbon accumulation, atmospheric humidity, adjustment of bouncing-pin indicator, and knock intensity are four important variables in knock testing which at present are not very well standardized. A recently developed springless bouncing-pin indicator appears to offer the possibility of considerably improved control of the last two.

The instrument incorporates a diaphragm identical to that used in the conventional bouncing-pin indicator and a modified pin proper, the lower end of which is separated from the diaphragm by a gap which is subject to control by a micrometer adjustment. The contact points are highly resistant to corrosion and have high magnetic permeability. One is carried on the upper end of the pin, about which is wound a coil of wire in series with the contact points. The upper contact point, of quite light weight, is free to move upward without restraint. The gap between the two points also is controlled by a micrometer screw, the two micrometer screws being the only adjustments provided. Initial contact of the points energizes the magnetic coil and holds the points in good electrical contact until separation is effected by the falling of the pin. The motion of the pin is substantially that of a freely projected body and results in greater sensitivity than that given by the conventional indicator, together with good stability. The good electrical contact resulting from the magnetic coil and the freedom from dust insured by the glass enclosure for the contact points, practically eliminate deterioration of contact points.

Standardization of the two micrometer adjustments would appear to offer the possibility of the elimination of the variations in relative fuel ratings due to differences in the adjustment of the springs of conventional indicators and perhaps provide a means, independent of fuel-depreciation characteristics, for the standardization of knock intensity. A cooperative study of the instrument is suggested, along with the proposed investigation of other promising instruments for knock measurement.

The Sunbury Knock Indicator – *E. S. L. Beale and Richard Stansfield, Anglo-Iranian Oil Co., Ltd.*

EVER since the bouncing pin has been used in detonation testing, it has been subjected to criticism from the standpoints of interpretation of the detonation phenomena and of the care and experience necessary for proper adjustment.

The Sunbury knock indicator differs from the bouncing pin in that it evaluates detonation by the stretch or vibrations in the cylinder picked up by an electromagnetic unit. The output of the pick-up unit is fed into a single-stage amplifier and measured by a standard knockmeter.

Work to date shows this equipment to be steadier, less sensitive to

(*Continued on page* 38)

What

Foreign Technical Writers Are Saying

AIRCRAFT

Testing Shock-Absorbing Struts

By W. D. Douglas and F. W. R. Bird. Published in *Aircraft Engineering*, July, 1937, p. 177. [A-1]

With permission of the Air Ministry the authors present in this article the method employed for dynamic tests of axially-loaded undercarriage struts at the Royal Aircraft Establishment.

They contend that owing to the complexity of the calculations necessary to determine the motion of the parts of an undercarriage during landing it is usually advisable to subject the combination of wheel and shock-absorbing strut to a representative dynamic test.

The test should represent as closely as possible the conditions under which the undercarriage operates during the landing of the aircraft, and it should be possible to obtain, during the test, complete records of the strut and tire closures and of the reactions of the strut throughout the stroke.

A testing machine of the falling weight type is used for this purpose at the Royal Aircraft Establishment. This machine is described, an outline diagram of a typical test assembly is given, and the test procedure is set forth.

Trailing-Edge Flaps

By S. B. Gates. Published in *Aircraft Engineering*, July, 1937, p. 183. [A-1]

This article constitutes a general review of the purpose of flaps, and how far they achieve it. The application of flaps in relation to landing and take-off. The properties of the trailing edge flap are discussed and the present state of flap design outlined.

The author concludes with a discussion of how much further it is possible to go with flaps and points out that such discussion usually boils down to an attempt to balance the advantage of much higher lift coefficients against the trouble—in complication, in weight, and in lateral control—involved in getting them. At Farnborough they appear to have proved that it is possible, with a slotted flap, to get almost as much lift as is possible with a full span flap, without pushing the aileron off the wing. This was accomplished by the use of slotted ailerons, which went down some 20 deg. as flaps and were used differentially from that position as ailerons.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

Die Luftschrauben des Luftschiffes LZ 129 "Hindenburg"

By Max Schirmer. Published in *Luftfahrt-Forschung*, June 20, 1937, p. 293. [A-1]

Here reported is the systematic series of model and full-scale tests which served as the basis for the development of the LZ 129 "Hindenburg" propellers. The first series of model tests were designed to find a remedy for two disadvantages in the original engine nacelle-propeller arrangement: the suspension of the nacelle below the ship caused a drag which might be avoided by internal mounting, and the position of the propeller axis below the center of the nacelle caused uneven airflow. Severe performance requirements as regards power, efficiency, vibration-free reverse running and long overhaul periods also indicated the need for extensive testing.

Preliminary model tests at various factories led to the choice of a four-bladed wooden propeller with massive duralumin leading edges for the blades. Determinations of the following five factors were then made with a 1/5 size model in the wind tunnel at Friedrichshafen:

pressure distribution on the nacelle, nacelle drag with open and closed cooling aperture and idling and stationary propeller; drag of the nacelle suspension means; thrust and torque for efficiency calculations, and velocity distribution behind the propeller.

As a result of these model tests, the efficiency of the propulsive unit was increased from 66 to 73 per cent. A three-bladed metal propeller was superior in efficiency, but had four detrimental features which counterbalanced this advantage. Additional type tests of strength and performance in the aircraft test stand revealed two defects in the propeller: the tendency of the metal edge to separate from the wood and blade flutter in reverse operation. Investigation of various leading edge arrangements led to the adoption of the final form which has resulted in satisfactory and maintenance-free operation.

Development work is now being carried on with a three-bladed metal and three and four-bladed seasoned wood propellers in the effort to attain increased efficiency.

Die Bestimmung des Widerstandes und der Durchflussmenge von Kühlern bei Verschiedenen Einbauanord nungen

By W. Barth. Published in *Luftfahrt-Forschung,* June 20, 1937, p. 300. [A-1]

To clarify, for a built-in aircraft radiator, the relation between airflow capacity of the core, the frontal area, the method of installation and drag is the object of this discussion. The findings are designed to assist the aircraft builder in the selection of the type and size of radiator installation.

Radiator drag, airflow capacity and velocity and installation efficiency are calculated on the basis of a few simple assumptions. The formulas developed are applied to a practical case. Conclusions are drawn as to the superiority of the faired over the unfaired radiator from the viewpoint of drag, as well as the distinct disadvantage of radiator shutters.

The Formation of Ice on Aircraft

By H. Noth and W. Polte. Published in *The Journal of The Royal Aeronautical Society,* July, 1937, p. 595. [A-4]

The author explains that the main reasons why trouble due to ice formation on aircraft was not experienced frequently in the earlier days are: (a) The greatly restricted amount of flying done during the winter and (b) the absence of means whereby flight in clouds for any considerable length of time was possible. He discusses the problem under the headings, processes and types of ice formation, special cases, effect of ice formation, weather conditions and ice formation, means for the prevention of ice accretion, procedure in the case of ice accretion.

An Analysis of the Flight of an Aeroplane When Directed by Means of a Radio Beacon for All Possible Values of Wind Velocity

By F. B. Greatrex. Published in *The Journal of The Royal Aeronautical Society,* July, 1937, p. 591. [A-4]

In these days of long distance flights across large stretches of ocean, airplanes will make considerable use of radio direction-finding apparatus, enabling them to keep their course on to a transmitting station at their goal. Over the Atlantic, for example, a series of beacons all the way across would be quite impracticable. The author gives an analysis of the course flown by an airplane under these circumstances, showing also the increase in flying time over that on a compass course, and also the maximum deviation from the compass course.

CHASSIS PARTS

Untersuchung uber die Quetschölverdrängung und Tauchschmierung bei Zahnradgetrieben

By E. Heidebroek. Published in *Kraftfahrtechnische Forschungsarbeiten,* No. 7, p. 44. [C-4]

Continuing a previously reported investigation of oil flow in gear lubrication, the present study is particularly directed toward splash lubrication. Observations were made stroboscopically, and here presented by means of a series of photographs. The effect of the direction of gear engagement with relation to the oil bath, gear speed and side play on oil pressure, for gears of both straight and beveled teeth, are shown.

That splash lubrication results in unstable oil flow when straight-toothed gears come into engagement before entering the oil bath is among the conclusions drawn. Under this condition, the amount of oil supplied, the gear speed and the width of the case have a decided effect on oil flow behavior. Lubrication is much more uniform when the gears come into engagement on emerging from the oil bath. When straight-toothed gears are running in an adequate oil supply, a pumping effect is caused which results in power loss amounting at times to 2 per cent of the total power. At peripheral speeds of more than 14 ft. per sec. atomization of the oil, foaming and admixture with air was found to take place. Bevel-toothed gears showed less pumping effect and oil heating than straight-toothed gears. The direction of engagement had the same effect with both gear types.

The investigation is said to indicate that the efficacy of splash lubrication is open to question, that it should be used only when peripheral speeds are lower than 10 ft. per sec., and when all operating conditions are maintained constant. These requirements are not met in automotive gear lubrication; hence a lubricating system providing a regular circulation of oil is suggested. In such a system, fresh oil would be supplied to the gears before the point of engagement, the used oil would be carried off, and after settling and cooling, be returned to the circulating stream.

The investigation is to be extended to friction effects between gear tooth flanks and to other forms of gear.

ENGINES

Fuel Economy

By Hector Rabezzana and Stephen Kalmar. Published in *The Automobile Engineer,* July, 1937, p. 260. [E-1]

This article is a report of a study of the effects of ignition factors investigated in a series of tests on a single-cylinder engine, and a multi-cylinder plant of a 1936 medium-size car. The only change from the set-up as installed in the car was a variable jet carburetor of the same type as the standard fixed jet carburetor. The engine was installed on a dynamometer and after the usual preliminary test runs, a fuel economy test was made at 1,000 r.p.m., corresponding to approximately 20 m.p.h. road speed, and at a constant load corresponding to level driving load at that speed.

The procedure followed was to take fuel consumption readings at progressively varying carburetor settings, keeping load and speed constant by changing the throttle accordingly at each setting. The results are plotted against carburetor air-fuel ratio, determined by means of a Cambridge exhaust gas tester. The first set of tests was run with spark plugs having small gaps. One test was made with the gap in normal position, one with the gap ¼ in. inward into the chamber, and one with the gap ⅜ in. inward from the standard position. Special spark plugs having long electrodes were used.

The second set of runs was made with large gaps in the spark plugs.

Considerable experimenting had to be done with the single-cylinder engine until the conditions found in the case of the multi-cylinder could be duplicated. In the final set-up, the plug location, valve timing and exhaust back pressure were as near as possible the same as in the multi-cylinder engine. The throttle was set to give approximately 20 per cent of full load with a maximum power mixture, and the carburetor was leaned down to give an air-fuel ratio of approximately 18:1. Under these conditions pressure-time cards were taken of, say, 30-40 consecutive cycles using first a small gap, then a large one, all other factors being kept constant.

An inspection of these records shows that generally the pressure cycles are not uniform. There are some evidencing a very slow initial combustion, some a normal burning. The slow burning can be partly compensated for by advancing the spark. With the large gap, the combustion, as evidenced by the pressure rise, is faster, and that for a given number of consecutive cycles the large gap gives more normal

cycles than the small gap, resulting in a higher beam load, and consequently, higher fuel economy.

Repeated tests have conclusively proved, the authors state, that unless all the factors contributing to the peculiar part load condition are present, i.e., lean mixture, spark plug location, valve timing, exhaust back pressure and throttle opening, no difference can be found in load and fuel economy, whether a large or small gap is used.

Of the three most important remedies, advancing the spark compensates for the slow burning mixture at the start. Changing the plug location puts the gap into a more ignitable mixture, and finally, increasing the gap size increases the probability of igniting a good mixture as the stratified mixture flows along the gap because of the discharge characteristics of large gaps.

Cool Combustion

By Laurence Pomeroy. Published in *The Motor,* July 6, 1937, p. 21. [E-1]

The author explains what is meant by "cool combustion" and progress in this development is traced. The advantages are discussed including the effect on supercharging and new designs incorporating this principle are referred to briefly.

Einrichtung für die Untersuchung des Spülvorganges in Kleinen Zweitakt-Schnelläuferzylindern

By H. Kluge, K. Von Sanden and W. Spannhake. Published in *Kraftfahrtechnische Forschungsarbeiten,* No. 7, p. 39. [E-1]

A test set-up for the direct observation of scavenging in a small high-speed two-stroke cycle cylinder comparable in size with that of a motor-cycle engine is here described. The upper portion of the cylinder above the exhaust port is replaced by glass section of the same size and shape; the piston is driven through a restricted stroke to avoid the necessity of lubrication and the consequent clouding of the glass; the pumped-in scavenging air is laden with finely powdered lime for visibility and light reflective ability and a stroboscope is provided for visual and photographic observation. The set-up has been operated up to a speed of 2,500 r.p.m. Future development will consist of more nearly approximating engine operating conditions by increasing the speed, lengthening the piston stroke and providing a cylinder content similar in specific weight to that of the combustion gases.

Leichte Dampfantriebe an Land, zur See, in der Luft

By Friedrich Münzinger. Published by Julius Springer, Berlin, Germany. 112 pp.; 202 illustrations. [E-1]

The technical aspects of steam power on land, sea and in the air are here discussed, with especial emphasis on the significance of steam power in the general effort to replace foreign with domestic fuels.

The first section deals with Germany's lack of petroleum resources and the competition between steam power and internal-combustion engines. Water-tube boilers with natural and forced circulation are treated in the second section. In the third, the prospects for steam power on land, sea and in the air are canvassed. The book is said to be the first attempt to assemble in one publication the technical considerations affecting the relative merits of steam and internal-combustion engines for the three spheres of utilization, and the first extensive examination of the merits of steam power for aircraft not solely devoted to thermodynamic questions.

Not much prospect for the extension of steam power in automotive operation is seen, because of its high first cost for a relatively small power requirement and because of its maintenance difficulties. The only feasible field is thought to be that of large motor-trucks and motor-coaches. Electric propulsion is thought to be a more probable substitute for internal-combustion engines in automobiles. In aircraft application, the prospects are somewhat brighter, although even here steam power will forge a place for itself only with difficulty, and with the expenditure of much time and money. Its task has been made doubly difficult because of the recent improvement in Diesel engines.

Ausstrahlung des Verbrennungsraumes Schnellaufender Dieselund Ottomotoren

By Lothar Bisang. Published in *Zeitschrift des Vereines Deutscher Ingenieure,* July 3, 1937, p. 805. [E-1]

Seven different methods so far utilized for determining the average temperature changes in a given portion of a combustion chamber were examined by the automotive and aircraft engine research department of the Stuttgart engineering college. Most of these methods were found to be not free from inertia effects, and hence not capable of giving accurate indications of the very rapid temperature variations in a combustion chamber.

An inertia-free apparatus for measuring heat radiation from a given section of a high-speed engine combustion chamber was then developed. In this heat is radiated through a quartz window in the combustion chamber and through a filter on to a photoelectric cell sensitive to ultra-red rays. The current variations in the photoelectric cell are amplified and recorded by means of an oscillograph.

An investigation of the operation of a high-

speed precombustion chamber type Diesel made with the help of this apparatus furnished the data for a detailed analysis of the course of combustion, here presented, and for conclusions as to the relation between injection timing and ignition lag. Tests made with an Otto cycle engine showed that benzol blends produce higher combustion temperatures than tetraethyl gasolines and that higher temperatures are found with advanced than with retarded ignition.

A method of calibrating the apparatus is now being developed.

MATERIAL

Plastic Materials for Aircraft Construction

By N. A. de Bruyne. Published in *The Journal of The Royal Aeronautical Society*, July, 1937, p. 523. [G-1]

The author points out in the introduction that any account of a subject in such an early stage of development as the use of synthetic resin materials for aircraft construction must necessarily contain a great many first thoughts and rough guesses. The study of the mechanical behavior of synthetic resins is largely the study of the properties of matter in an amorphous state. In contrast to that of single crystals, which has attracted so much interest and been so productive of results in recent years, the author contends, knowledge of matter in its most extreme polycrystalline form is meagre.

The work of other investigators is cited and the subject is discussed in two parts: Part I – Properties and Part II – Applications.

Four-Ball Top for Testing the Boundary Lubricating Properties of Oils Under High Mean Pressures

By G. D. Boerlage and H. Blok. Published in *Engineering*, July 2, 1937, p. 1. [G-1]

The Four-Ball Top, which has been developed for testing the boundary lubricating properties of lubricants, particularly under high mean pressures, employs the four-ball principle which was utilized in the four-ball apparatus for testing extreme-pressure lubricants described in *Engineering* in 1933. Both instruments are used for testing lubricants under boundary conditions, that is, under high mean pressures, but whereas the four-ball apparatus works with fairly high sliding speeds (50 cm. per second and more), the Four-Ball Top works with very low sliding speeds (0.1 cm. per second to 1 cm. per second). It is also arranged so that the oil cup can be heated electrically up to 300 deg. C. By means of the instrument, which has been developed at the Delft Engine-Testing Laboratory of the Royal Dutch Shell Company, Holland, the influence of temperature on the friction coefficients for various oils has been tested and plotted in temperature-friction coefficient curves. The influence of combinations of different metals on boundary lubricating properties has also been studied.

The instrument has been designed particularly for the purpose of testing boundary lubricating properties at pressures of 10,000 kg. per square centimeter and higher, and at low sliding speeds of 0.1 cm. to 1 cm. per second.

The apparatus and method of test are described in detail.

In a discussion of results the authors point out that the large number of tests which have already been made show discrepancies not greater than 3 per cent to 4 per cent, which is very good for tests under extreme boundary lubrication conditions. Speaking generally, the greatest differences between lubricants become apparent in the region of higher temperatures, that is, at 100 deg. C. and above. Mineral oils show an almost constant friction at temperatures up to the so-called breakdown temperature. Fatty oils, at room temperature, show only slightly less friction than mineral oils at normal load; at increasing temperatures, however, the friction decreases gradually until breakdown occurs. The breakdown temperatures of fatty oils are generally below 200 deg. C., which is lower than those of many straight mineral oils which break down at 250 deg. to 300 deg. C. or even higher temperatures.

The Coefficient of Static Friction of Different Lubricating Oils Measured with the "Redgrove Apparatus"

By D. J. W. Kreulen. Published in the *Journal of the Institution of Petroleum Technologists*, July, 1937, p. 452. [G-1]

In 1935 E. R. Redgrove introduced a simple apparatus for testing the "oiliness" of lubricating oils and described it in a paper published in the *Journal of the Institution of Petroleum Technologists*. Mr. Kreulen in his paper explains that since the results obtained with this apparatus, as reported by its designer, suggested that it would be possible to obtain in this simple way valuable information with regard to the "oiliness" of a given lubricating oil, he built a similar apparatus for the purpose of conducting check tests on lubricating oils of different character. His results are reported in the present paper.

Contrary to the experience obtained by Redgrove, serious difficulties were encountered in the beginning with regard to a satisfactory agreement of results. In revising the test method Mr. Kreulen decided to employ polished surfaces; and in order to eliminate the factor of surface tension during the measurement of the coefficient of static-friction, placed the slider and balls under the oil to be tested. The method of test is given in detail.

The coefficient of static friction was determined for seven oils, five of which were mineral oils, and the results are given in tabular form.

From the results the author points out that it appears that the base of the oil is not responsible for the coefficient of static friction, since, of the paraffinic-base oils examined, one has the highest coefficient obtained for mineral oils, the other the lowest. This is in accordance with the theory of polar compounds, which claims that certain compounds independent of the base of the oil are responsible for the value of the coefficient of static friction. The possibility that naphthenic-base oils are more liable to form acids, which act as polar compounds and consequently lower the coefficient of static friction, than paraffinic-base oils, is cited. The results likewise indicate that compounds are formed in storage.

In this investigation neutralized fatty acids were also tested which gave results which indicated that the expected lowering in coefficient of friction of oils with a high coefficient really exists and that the curve for the compounded oil is not only much lower than that of the original oil but there is a tendency to reach the end-value more rapidly. Further tests indicated that not only the addition of concentrated polar compounds, but the addition of relatively small quantities of an oil with a low coefficient of static friction will also have a very important effect.

MISCELLANEOUS

Parallèle de l'Autorail et de l'Automobile dans leur Conception and leur Utilisation

By Victor Nicolet. Published in *Journal de la Société des Ingénieurs de l'Automobile,* April, 1937, p. 213. [H-3]

Writing with the authority of his experience as chief engineer in charge of materiel and traction of the national railroads of France, the author discusses in a general and non-technical manner the questions common to the automobile and the railcar, the future of the railcar, and the problems in connection with it still remaining to be solved.

While the railcar was born of automobile competition, and has helped to provide the two weapons of higher speed and more frequent schedules necessary to combat that competition, it is not the universal panacea for railroad ills, the author concludes in his first section dealing with the technical sphere of various methods of transportation. Steam and electric power still have important places to fill, and must be utilized and improved. An analysis is made of the railcars in use in France, and the makes and general characteristics of the vehicles operating in various types of service are enumerated. About 600 railcars cover approximately 90,000 miles daily in France. Engines, transmissions, suspensions, tires, bodies and braking are each briefly discussed in the summary of design features of French operated railcars, and comparisons are made with the practice of other countries.

Dealing with the orientation of the railcar, present and future, in the general scheme of transportation, the author claims that the railcar has opened up new horizons for the railroad, making possible a reclassification of ground transport means, and elimination of competition between rail and road travel. To the airplane he assigns emergency transport and trips of 600 or more miles; the automobile he restricts to distances of less than 60 miles. Railroads will maintain only main arterial lines; secondary branches would never have been constructed if the automobile had been invented 20 or 30 years earlier. Passenger trains will be grouped into 3 speed classes, according to the type of service, 100 m.p.h., 75 m.p.h. and 50 m.p.h. Goods trains will maintain an average speed of 35 m.p.h. This goal imposes an improvement of about 50 per cent over the present French practice.

About Authors

(*Continued from page 11*)

of machine design at Virginia Polytechnic Institute. In 1936 he was advanced to associate professor. He is a prolific writer and has contributed numerous articles on lubrication to technical publications. Professor Clower received his M.E. degree from his Alma Mater in 1929.

● Charles S. Draper *has been on the Massachusetts Institute of Technology staff since 1929, specializing in instruments for aircraft and internal-combustion engines. During the past year he has been in charge of the development of vibration measuring equipment for use in aircraft. A native of Missouri, his education was received at Missouri University, Stanford and M.I.T. He has degrees in psychology and electrochemical engineering, in addition to a master's degree for work in the field of internal combustion engines. Mr. Draper is first lieutenant in the Army Air Corps and holds a Department of Commerce private pilot's license.*

● R. F. Gagg *is the 1937-1938 vice-chairman for aeronautics of the Metropolitan Section. Although he has but recently become a member of the SAE he has long cooperated with the Society in its aircraft and research activities. He was co-author of a paper presented at the*

International Automotive Engineering Congress, sponsored by the SAE in 1933, and in December, 1934 he spoke before the Met. Section. Mr. Gagg received his B.S. from the University of Colorado in 1923 and his M.E. from Yale two years later. That year he joined the Climax Engineering Co. as assistant Diesel engineer and in 1927 was made assistant chief engineer. Leaving Climax in 1930 he became experimental engineer for the Wright Aeronautical Corp., supervising tests of air- and liquid-cooled engines. He was advanced to assistant chief engineer in 1934.

• J. H. Pitchford *read engineering at Cambridge University from 1923 to 1926 when he was graduated. During his vacation in 1925 he worked with Ricardo & Co., joining the staff of that firm after graduation. In that company he has specialized in combustion research on high-speed compression-ignition engines and on the application of the results of this research to the development of suitable engines for the licensees of his company. Mr. Pitchford is author of a number of lectures and papers dealing with these engines.*

• Harry R. Ricardo *did much to stimulate American engineers' interest in detonation at the 1922 SAE Annual Meeting when, at the invitation of the Society, he expounded his internal-combustion engine researches that had been attracting much attention on both sides of the Atlantic. Most of this work had been done in the Ricardo & Co. laboratories which he had founded at Shoreham, England, in 1917. There, in 1918-1921, he carried out researches for the Shell Co. into the properties of gasoline. These studies confirmed theories of the late Professor Hopkinson, under whom Mr. Ricardo studied at Cambridge University and later assisted, as to the mechanism of detonation and turbulence and the influence both of the composition of fuel and of the form of the combustion chamber on these factors. He established the Toluene number which was generally accepted in Europe as an index of the detonation tendency of the fuel, prior to the substitution of Octane. Since 1922 he has been carrying on a program of research and development work on high-speed Diesel engines on behalf of the Shell Co. and on sleeve-valve aeroplane engines on behalf of the Air Ministry (for which he is consulting engineer) and later the Bristol Aeroplane Co. He was elected a Fellow of the Royal Society in 1928 in recognition of his pioneer work on high-speed engines and their fuels. He has been a foreign member of the SAE since 1922. Unable to attend the 1937 Summer Meeting he sent his co-author, J. H. Pitchford, to this country to read the paper and respond to the discussion it created.*

• C. G. A. Rosen *draws upon fuel research conducted at the San Leandro Laboratory of the Caterpillar Tractor Co. to discuss and amplify a paper presented by G. D. Boerlage and J. J. Broeze before a meeting of the American Chemical Society. Mr. Rosen has been active in Diesel engineering for more than 20 years. Since 1929 he has been engaged in the development of mobile Diesels for the Caterpillar Company.*

• Pierre Schon *has been connected with the automotive industry since the days of "hot tube ignition." Leaving college at Longuyon, France, in 1897, he served his apprenticeship in the Panhard-Levassor and Renault factories. After some racing experience in 1903, he set a new pace in commercial transportation with a 90 hp. Mercedes racing car, rushing Paris evening papers to the midnight boat at Le Havre for the morning readers in London. Colonel Nelson, owner of the Kansas City Star heard about this new method of speeding-up the distribution of newspapers, and in 1904, Mr. Schon came to Kansas City and set up one of the first motorized newspaper deliveries in the United States. In 1912 he became branch manager for the Mack Co. in Kansas City and two years later started with General Motors Truck Co. as service manager. He was transferred to the Sales Division in 1916 and during his 23 years with G.M.C. has held various executive capacities. A member of the SAE since 1919 he has taken a prominent part in T & M Committee activities. He originated the program of standardizing C.A. Chassis dimensions in 1930.*

• H. Hugh Willis, *after graduating from Oberlin College in the class of 1925, joined the staff of Columbia University as assistant in physics. Three years later he was made instructor. In 1931 he gave up teaching to take his present position as head of research laboratory, Sperry Gyroscope Co. He was born in Marengo, Iowa.*

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adjustment, and to have a shorter time constant than the bouncing pin. It is still too early to know definitely its correlation with the bouncing pin and road octane-number ratings.

Spark-Advance Indicator – *J. R. MacGregor and K. R. Eldredge, Standard Oil Co. of Calif.*

IN the study and operation of mechanisms there are many instances where the interval ratio of cyclic events requires evaluation. In research involving the use of gasoline engines, such a device fulfills a long-felt want in providing a means for instantaneously and continuously indicating spark advance.

The spark-advance indicator has been developed for road-test work and is designed so that connections are made readily to the engine by electrical means; back-lash and other errors inherent in mechanical drives are thereby eliminated. The spark advance, without regard to the engine speed, is indicated on a meter placed at any convenient location, and the indicated values are in terms of degrees ahead of a predetermined datum point, such as top-center.

A Spark-Advance Indicator for Road-Test Use – *J. B. Macauley, Gilbert Way, and Sidney Oldberg, Chrysler Corp.*

THIS paper describes the construction and calibration of an instrument that will give instantaneously the spark advance obtained while operating a car on the road. Preliminary results obtained with the instrument are presented and include road tests on five cars.

Automatic Speed-Load Dynamometer Control – *J. R. MacGregor and L. T. Folsom, Standard Oil Co. of Calif.*

AUTOMOBILE and engine testing often is facilitated by having a dynamometer which will apply a test load having a predetermined relationship to the speed of the engine. More particularly is this instrument desirable in testing for warm-up, detonation, carburetor-acceleration characteristics, and so on.

By providing rotating masses having inertia equivalent to that of the automobile whose engine is being tested and superimposing a load equal at all speeds to that necessary to drive the automobile under specified road and grade conditions, road testing can be brought into the laboratory where controlled conditions allow duplication from run to run.

An apparatus has been developed which accomplishes the described results. It consists of a direct-current dynamometer, a motor-driven auxiliary compound-wound generator, a source of direct current, and miscellaneous control rheostats, switches, and so on. The auxiliary generator is used to excite variably the main generator so that its output follows the desired speed-load relationship of the engine under test.

Valve-Gear and Crankshaft Vibration Studies with Cathode-Ray Oscillograph – *Max M. Roensch, Maynard Yeasting, and Sidney Oldberg, Chrysler Corp.*

THIS paper is concerned with vibration problems of engines with the object of obtaining greater smoothness by means of new and novel instrumentation for analyzing and measuring vibrations.

What the Trailer Means to the Car Manufacturer – *James H. Booth, Buick Motor Co.*

(Paper published in full, pages 221-224, Transactions Section, June issue.)

Hypoid Gears, Axles, and Lubricants – *W. A. Witham, Gleason Works.*

THIS paper discusses the most recent developments and best practice in both the design and manufacture of hypoid gears and axles.

Due to improved machines, methods, and materials, hypoid gears now are being produced to higher standards of accuracy and precision than has heretofore been possible to produce any type of rear-axle drive gears. Also we now have full control of all tooth bearing characteristics, including length, profile width, and the general shape of the contact area.

To utilize such improved gears to the greatest advantage similar advances are being made in the design and manufacture of hypoid axles. Greater rigidity of the gear mountings and the highest possible degree of precision in producing uniform axles are required, as well as proper provision for control of the tooth bearing in assembling the axle.

Latest methods for producing hypoid gears are discussed, including an

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analysis of the Formate type of gear. A summary of the results of a number of deflection tests on various types of axles serves to illustrate various factors entering into axle design.

The load-carrying capacity of hypoid gears, properly lubricated with a suitable extreme-pressure (E.P.) lubricant, is calculated on the same basis as for spiral bevels.

Need for Simplifying Recommendations of Transmission and Rear-Axle Lubricants – *C. M. Larson, Sinclair Refining Co.*

SINCE the publication of the original classification of transmission and rear-axle lubricants back in 1931, evolution has seen the development of a most complicated and varied number of gear-lubricant recommendations for the millions of cars now on our highways.

Each year, as new features are introduced, changes are made which affect gear-lubricant requirements of the past. Yet nothing is done each year to revise car manufacturers' lubrication charts made up previously. A composite grouping of gear lubricants would simplify the servicing of cars on the road.

At the present time, the service-station attendant is required to follow with exactness lubrication charts for each and every make and model of car if he would keep the car owner out of trouble. On the other hand, the service-station needs are filled best by the smallest number of grades required for proper servicing since large inventories and especially gear-lubricant dispensing equipment (metered) are costly.

Tests and practical experience have shown that economy and satisfaction can be effected with stable non-corrosive mild E.P.'s for all transmissions of the conventional, overdrive, and free-wheeling types, as well as for all rear axles other than hypoids – the latter requiring active, powerful hypoid-gear lubricants.

Report of the Volunteer Group for Compression-Ignition Fuel Research – *T. B. Rendel, Shell Petroleum Corp.*

FOLLOWING the adoption of a suitable design of engine and a tentative procedure for operating this engine, the work of the Volunteer Group has covered the investigation of other methods of measuring cetane number of Diesel fuels looking towards a simplification and improvement of reproducibility of the procedure.

Results of a second series of cooperative tests are given, using the procedure adopted in the Group's last report together with a series of tests on the same fuel using the critical-compression-ratio method with an interval timing-control device. Results of the first series do not show such good agreement, the grand average deviation on twelve samples being of the order of ± 1.9. Results of the critical-compression-ratio tests show improved agreement due to better standardization of details.

Tests on three alternative methods based on the delay method, but using different instruments for recording the delay, are given. Results on two different types of full-scale engines also are presented as an indication of the validity of the laboratory test methods.

It is concluded from the results of the past 18 months' work that a direct matching method on the basis of ignition delay is the best from the point of view of reproducibility and validity, even though this method will involve some sacrifice in simplicity and speed of testing. The progress of methods of instrumentation has advanced considerably, and it appears that the bouncing-pin type should be discarded in favor of a balanced-diaphragm or magnetic-pickup type.

Behavior of High- and Low-Cetane Diesel Fuels – *R. A. Rose and G. C. Wilson, University of Wisconsin.*

(Paper published in full, pages 343-348, Transactions Section, August issue.)

Development of the Murphy Diesel Engine – *M. J. Murphy, Murphy Diesel Co., Ltd.*

THIS paper covers twenty years of development starting with the true Diesel type, progressing to various highly turbulent designs, gas-injection precombustion types, and so on, then back to a full Diesel with open combustion-chamber and unit injector.

Artistic Streamlining Against the Wind Tunnel – *Alexis de Sakhnoffsky, engineering stylist.*

IN this paper the author backs his contention that deep knowledge of aeronautics is not a requisite of artistic streamlining design by pointing to recent successful models designed by using principles directly opposite to the requirements of the wind tunnel.

(*Continued on page 42*)


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Continued

Various features of these two fields of design are compared. Data showing improved economy and performance effected by streamlined truck design are presented.

Function in Modern Styling – *Frederic A. Seljé, director, interior art and body design, Chrysler Corp.*

UTILITY and function comprise the basis upon which modern automotive interiors, as well as exteriors, are styled. The layman understands these words to mean, "to be useful; to act" – the engineer knows that they are prime essentials in his activities; the industrial designer welcomes them as emancipation from the clutter of meaningless ornamentation which enables him to approach each new problem with freshness and freedom of thought. To him, there must be a reason for every detail; in his scheme, beauty alone is no longer an excuse for being.

This approach to style has created its own school of design, the purpose of which is to transpose art into industrial and commercial values.

In this paper methods by which this transposition is accomplished are described, as well as the type of personnel required and the factors which influence their work. Also the connection between style and customer acceptance is shown and how it can be made to produce profits or losses.

Recent Trends and Developments in European Automotive Diesel-Engine Design – *H. R. Ricardo and J. H. Pitchford, Ricardo & Co.*

(Paper published in full, pages 405-414, Transactions Section, this issue.)

Diesel Streamliners – Operating and Maintenance Problems and Economies – *F. J. Jumper, Union Pacific Lines.*

THE advent of the high-speed Diesel-electric streamlined train into railway transportation has opened up a relatively new field for the railroads.

Foremost problems which confronted the designing engineers were the design of car bodies, reduction to a minimum of the amount of dead weight carried, development of suitable powerplants for propulsion which would prove dependable and provide continuous service for long non-stop transcontinental runs, design of suitable accessory equipment such as steam-heating boilers and air-conditioning systems.

Also they had to develop satisfactory auxiliary powerplants to provide a constant source of power for operation of the auxiliary equipment independent of train movement, and to develop a satisfactory braking arrangement, coordinating these with other problems involved to insure the practical and successful operation of the complete train.

Milwaukee Section Paper

Feb. 15, 1937

High-Speed Diesel-Electric Zephyr-Type Trains – *E. F. Weber, superintendent of automotive equipment, Burlington Lines.*

THIS paper gives a comprehensive general picture of the Diesel "Zephyrs" – their development, design, and operation. Since completion of the original Zephyr in April, 1934, seven more of these Diesel-electric trains have been added to the Burlington Lines. Daily mileage of the eight is 5900 with a combined availability of above 97 per cent. Early operation troubles are described, resulting in the building up of a highly coordinated maintenance personnel.

The Diesel engines used are discussed, and their specifications given, with special attention to the cooling system. Specifications of locomotives, cars, and stainless steel also are tabulated; operating costs are revealed.

Metropolitan Section Paper

March 8, 1937

Modern Trends in Motor Oils – *Dr. George M. Maverick, Standard Oil Development Co.*

IN lubricating the compact, high-speed motors of today throughout all the abuse that they are obliged to take, an oil is good only if it rates high in the following features: low consumption; must allow

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winter starting with the least effort; must flow instantly on the coldest start; must not form sludge, stick rings, or leave excessive carbon on vaporization; must withstand greater loads and higher speeds; and must not break down with the formation of products corrosive to bearing materials.

During the past few years there has been a trend toward making the higher grades of oils by extensively refining a selected petroleum fraction to furnish a clean high boiling base and then adding relatively small quantities of synthesized materials to impart the desired final properties. The addition agents now available and widely used include materials for increasing viscosity and viscosity index; for reducing pour points; for giving greater oiliness; and for increasing resistance to oxidation and preventing bearing corrosion.

This paper points out some of the advantages and dangers in the use of such addition agents, with conclusions backed by test results on some of these materials.

Canadian Section Paper

March 17, 1937

Some Transmission Developments – *S. O. White, chief engineer, Warner Gear Division, Borg-Warner Corp.*

IN spite of recent intense activity in their development, this paper points out that present transmissions are essentially what they have been for many years past. It is conceded, however, that they have been made smaller, quieter, and more efficient, and that the synchronizer has improved gear-shifting.

Various methods of remote control are reviewed, and operation and advantages of overdrives and free-wheeling are discussed. Other developments considered are the British Wilson gear box and various types of automatic transmissions.

Metropolitan Section Paper

March 24, 1937

Nitric Oxide in the Exhaust Gases of Internal-Combustion Engines – *Walter E. Arnoldi, Stevens Institute of Technology.*

THIS paper discusses the results of an investigation undertaken at Stevens Institute of Technology during the summer of 1936 by three undergraduate students: Jonas Anderson, Arnold Arons, and the author.

A complete description of methods of chemical analysis of exhaust gases for nitric oxide and of the experimental technique of the project is included in the joint report.

The work was undertaken to determine the amounts of nitric acid formed and the factors affecting its formation in internal-combustion engines. Application of the results to crankcase corrosion remains to be investigated.

Detroit Section Papers

March 30, 1937

High-Speed Trains – *Thomas H. Henkle, western sales manager, Edward G. Budd Mfg. Co.*

ADVANTAGES of welded stainless-steel construction of high-speed light-weight trains are set forth in this paper. Development of the "Shotweld" method for speeding up and improving stainless-steel welding is described. Strong structures of light weight are stated to be the result of this welding process, of the high strength and non-corrosiveness of the steel, and of the proper distribution of the material.

General specifications and operating data on eight "Zephyr" Diesel-electric trains made by these methods are presented. Developments in brakes for these trains are outlined.

The author sums up the advantages of high-speed trains of this construction under headings of greater safety, greater riding comfort, cleanliness, clearer vision, greater availability, reduced maintenance and operating costs, and increased revenue.

THE MOST INTERESTING DEVELOPMENTS

1) in Aircraft
2) in Aircraft Engines
in 1937

as seen by

A. L. Beall

SAE Vice-President,
Representing Aircraft-Engine Activity

and

Fred E. Weick

SAE Vice-President,
Representing Aircraft Activity

★ ★ ★ ★ ★ **Turn to next page, please**

The 1500 Hp. Engine

By A. L. Beall

SAE Vice-President, Representing Aircraft-Engine Activity

Unquestionably, in the engine field, the development of the greatest interest in the year 1937 is the 1500 horsepower engine.

The engine of 1000 horsepower was the product of steady but slow growth over a period of years with a takeoff horsepower output in four figures representing the climax of a series of small increases in horsepower made possible by better designs and better materials.

Apparently, the aircraft industry has arrived at the conclusion that there are many advantages in the use of two engines, as opposed to four, which can be realized if the total power output is not seriously below that of four engines at takeoff. Economy of installation of two engines, the reduced maintenance, and the greater simplicity of controls for the pilot with two engines, as compared with four, all have a distinct appeal to the aircraft industry.

Coincident with the crystallization of thought in favor of two engines of adequate power came the fourteen-cylinder two-row radial engine with 1500 brake horsepower for takeoff and commensurate cruising output. No development in the engine field in recent years has been more timely or accomplished with fewer pangs of parturition.

The most interesting development in aircraft during the past twelve months is, to the writer, an admittedly prejudiced observer, the application as carried on jointly by the Army Air Corps and the Douglas company of the tricycle landing gear to larger airplanes.

The transport airplane should be benefited in three distinct ways by the adoption of the tricycle landing gear. First, blind landings will be easier, for the landing can be made at any reasonable speed without necessarily leveling off the flight path before contact with assurance that the airplane will stay on the ground after contact is made. In addition full application of the brakes during the entire ground run can be made without danger of nosing over. Second, because the tricycle gear is stable in taxiing and free from the tendency to ground loop, landings can be made easily and safely with the wind blowing strongly across the runway, and it therefore seems likely that airports having only one long runway may be satisfactory. Third, the tricycle gear should contribute to the comfort of transport passengers for the fuselage floor is level when the airplane is on the ground.

Experiments in application of the tricycle gear to larger airplanes have been carried on by the Air Corps and the Douglas company in a sound and thorough manner. Starting with the information gained from installations on small airplanes, systematic ground tests were made with a towed carriage fitted with a tricycle gear, several features of which could be varied. After these tests a tricycle gear was fitted to a Douglas Dolphin amphibian having a gross weight of 9000 lb. This was put through a series of take-off and landing tests and then flown by many different Air Corps pilots at various Air Corps fields throughout the country.

During the same time the N.A.C.A. has been continuing the investigation of certain factors connected with tricycle gears, particularly those having to do with the possible shimmying of the front wheel which would be serious if it occurred on larger airplanes.

With this background, the next step in the development is now taking place in the use of a tricycle gear on the new forty-passenger Douglas DC4 four-motored transport having a gross weight of 60,000 lb. which is now being completed.

Tricycle Landing Gear

By Fred E. Weick

SAE Vice-President, Representing Aircraft Activity

John K. Ball

Robert J. Minshall

Fred P. Laudan

Announcing

Award of the Wright Brothers Medal for 1936

to

ROBERT J. MINSHALL JOHN K. BALL and FRED P. LAUDAN

of the Boeing Aircraft Co.

for their paper entitled

"DESIGN AND CONSTRUCTION OF LARGE AIRCRAFT"

which was presented at the First National Aircraft Production Meeting held by the Society of Automotive Engineers in Los Angeles in October, 1936.

THE Wright Brothers Medal is awarded annually to "the author of the best paper on aerodynamics or structural theory or research, or airplane design or construction, which shall have been presented at a meeting of the Society or any of its Sections during the calendar year."

Previewing the National Aircraft Production Meeting

Photo by W. J. Chamberlin, SAE Journal Field Editor for Southern California Section

Carleton E. Stryker, again general chairman of the SAE National Aircraft Production Meeting, makes last-minute organization plans for the three-day event.

CLIMAXING what experts forecast as the aeronautic industry's first $100,000,000 year is the second annual SAE National Aircraft Production Meeting being held Oct. 7, 8 and 9 in Los Angeles. Attending are executives and engineers of companies that produce practically all the aircraft, engines, parts and equipment that are being valued at this huge figure.

Looking ahead to even greater years these men are convening in Los Angeles to concentrate on the utilization of raw materials, production processes, engine installation and flight testing, *every phase of aircraft construction.* Criticism of planes as they are delivered to operators – both military and civil – will come from experts on operation and maintenance. The full program of the meeting precedes this article.

S. D. Heron, Aircraft-Engine Meetings Committee chairman, helped develop vigor and variety in the papers.

Just before hopping off to the Pacific Coast, the Society's Secretary and General Manager John A. C. Warner said of this meeting, "Now is the time for it; 1937 production is running 25 per cent ahead of last year's and, with conditions as they are, there is no telling how great 1938 production will be. Personally I look for a considerable increase. The Society's National Aircraft Production Meeting is the only forum at which the men who plan for production can meet, exchange ideas and smooth out mutual manufacturing and maintenance problems.

"It is hard to conceive that the estimated 1937 production of aircraft, engines and parts is valued at eight times as much as that produced in 1925. Seven hundred per cent increase in 12 years is quite a jump; yet the industry is just approaching the "mass production" stage. The reason for these annual production meetings is to give executives and engineers an opportunity to get together, think together and plan together to avoid costly production pitfalls in meeting forthcoming problems. It is not a matter of sharing secrets but of avoiding economic waste."

The SAE, in its aeronautic ac-

Peter Altman, Aircraft Meetings Committee chairman, got striking results from strenuous efforts in program-building.

Southern California Men Participate in

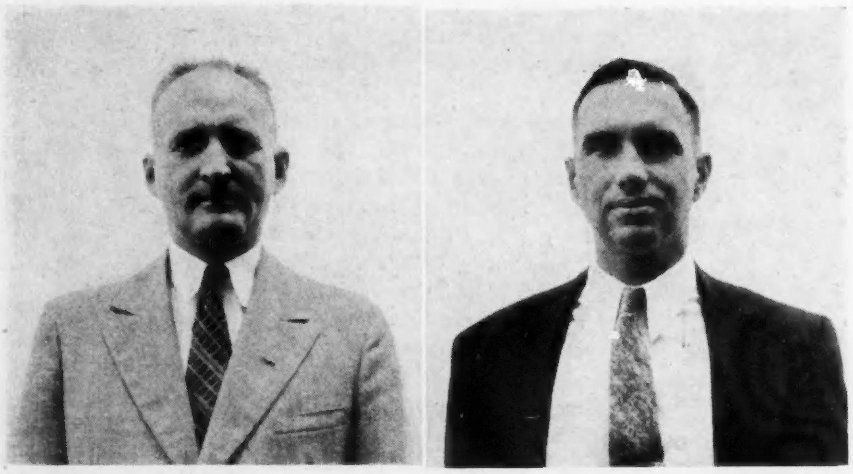
Donald H. Wood talks on the "Present Status of Cowling," at the opening session.

Photo by W. J. Chamberlin, SAE Journal Field Editor for Southern California Section

A group of Southern California Section Members and others interested in the National Aircraft Production Meeting gather at one of General Chairman Stryker's program-planning meetings. Above are: Richard M. Mock, who cooperated in developing the Aircraft Operation and Maintenance Session; H. D. Ingalls; and H. D. Houghton, who presented a paper at last year's meeting.

Col. E. J. W. Ragsdale of E. G. Budd Manufacturing Co., draws upon his company's experience in speaking on "Engineering for Production in Stainless Steel" at the Production Session.

Co-Authors Whose Paper Opens Meeting



A. Lewis MacClain and R. S. Buck, both of Pratt & Whitney, joined to write, "Flight Testing with an Engine Torque Indicator," the meeting's opening paper.

tivities, has more than kept pace with the thriving aviation industry. Back in 1920 only two sessions at the Society's national and regional meetings were devoted to aircraft. This year the number has increased to 22 at which 47 aviation papers are being presented. Seventeen of them are being given at Los Angeles. General Chairman Carleton E. Stryker, chief engineer, Curtiss-Wright Technical Institute, with his committees, has worked in close cooperation with SAE President Harry T. Woolson and the Society's aviation vice-presidents, Almon L. Beall *(aircraft engine)* and Fred E. Weick *(aircraft)*, in making this Second Aircraft Production Meeting outstanding both in quality and timeliness of papers and smoothness of running.

Coast-to-coast commercial flying has just passed its tenth anniversary. Many of the developments that have enabled the airlines to offer the dependable service that now carries more than a million trans-continental passengers each year at double the speed and with fares less than half those of a decade ago, can be traced to ideas first announced in papers presented at SAE meetings and published in the SAE JOURNAL.

Members of the Society have actively participated in this development. Nearly all of the 3010 airplanes manufactured in 1936 in this country were built in plants where SAE members are executives, engineers and designers. Most of the procurement officers who bought 1141 military aircraft last year are members of the

SAE National Aircraft Production Meeting

Photo by W. J. Chamberlin, SAE Journal Field Editor for Southern California Section

Cooperating in making local arrangements are SAE Members L. J. Grunder, 1936-1937 chairman of the Southern California Section; E. E. Tattersfield, chairman of last year's successful banquet committee, who holds the same job for this meeting; and W. E. Powelson, Section vice-chairman last year, who for years has been an effective SAE worker in Los Angeles.

Hall Hibbard is chairman of the Aircraft Processes Session.

Major J. T. Morris tells about "Maintenance Problems of Army Airplanes."

Lieut. H. Knox Perrill, U. S. Navy, who participated in a recent mass flight to Honolulu, presides at the Operation and Maintenance Session.

Society and nearly all of the commercial aircraft purchased by airlines were bought by companies which employ SAE men in executive and engineering capacities.

The very real success of last year's National Aircraft Production Meeting is reflected in the increased number of the industry's men gathering in Los Angeles for the 1937 event. Advance reservations for this meeting could be bound as a "Who's Who" of aircraft executives and engineers, and miss but a few names. Seventeen papers are included in the seven carefully balanced sessions.

The Southern California Section, host to the meeting, has done an exceptionally fine job in arranging for the comfort and entertainment of the visitors. Its members are providing transportation for the inspection trip to the world renowned laboratories of the California Institute of Technology in Pasadena. They are also taking charge of the Aviation Banquet that will climax this three-day meeting.

A high spot of the meeting will be the award of the Wright Brothers Medal *(see p. 16)* for the best paper on aerodynamics or structural theory or research, or airplane design or construction presented before the Society in 1936, to three Boeing men, R. J. Minshall, *chief engineer,* John K. Ball, *chief stress engineer,* and Fred P. Laudan, *plant superintendent.* Their paper, "Design and Construction of Large Aircraft," which gained them this honor, was first presented at the 1936 National Aircraft Production Meeting.

T. P. Wright, 1934 vice-president of the SAE Aircraft Activity, and Mac Short, holder of this office in 1936, are, respectively, chairmen of the Materials Session and the Production Session.

About SAE Members:

. . . . At Home and Abroad

Prof. Chauncey W. Smith, is on sabbatical leave from the University of Nebraska. He is at present doing some graduate work at the University of California, Berkeley, Calif.

C. M. Larson recently has been advanced to chief consulting engineer by the Sinclair Re-

C. M. Larson
Promoted

fining Co., with headquarters in New York. Prior to his promotion Mr. Larson was supervising engineer.

William B. Stout, president of the Stout Engineering Laboratories, Inc., recently was awarded a patent titled "Motor Car" which covers the general construction of his Scarab car.

T. P. Wright, vice-president of the Curtiss-Wright Corp. in charge of engineering, recently received the degree of Doctor of Science from Knox College, Galesburg, Ill. Mr. Wright has also been elected a Fellow of the Royal Aeronautical Society of London.

Frank J. Hierholzer has been promoted from the commission of first lieutenant to captain of the second ammunition train, United States Army. He is located at Fort Sill, Okla., having recently been transferred from Fort Knox, Ky.

Walter and Clarence Fishleigh, Detroit consulting engineers, cooperated with designers, engineers and production men of the American Bantam Car Co., in making production plans for the new American Bantam line of cars and trucks.

Rolf C. Haferl, formerly design engineer with General Motors Truck Corp., Pontiac, Mich., is affiliated with the Ward Motor Vehicle Co., Mt. Vernon, N. Y., as body engineer.

On A.T.A. Program

Four SAE members participated in the program of the American Transit Association Bus Division at the A.T.A. Convention held at White Sulphur Springs last month. O. D. Treiber, chief engineer, Diesel Division, Hercules Motors Corp., conducted the clinic on Diesel Engine Developments; Eugene C. Schultz, assistant superintendent, automotive equipment, New Orleans Public Service, Inc., the clinic on Testing Engines for Efficiency After Overhaul; D. E. Blair, general superintendent, Montreal Tramways Co., the clinic on Degassing Devices; and Floyd L. Wheaton, superintendent of automotive equipment, Detroit Department of Street Railways was co-chairman of the clinic on Bus Inspection and Maintenance Systems.

Orville Wright and his brother, the late Wilbur Wright, recently were honored when bronze busts of the two men were placed in the Army Aeronautical Museum at Wright Field, Dayton. The busts were the work of Sculptor Seth Velsey. He made Wilbur Wright's likeness from photographs supplied by Orville Wright. The latter sat for his own bust.

Douglas F. Linsley has resigned as chief engineer, Vaco Products, Inc., Detroit, to join the sales engineering staff of Houde Engineering Corp., Buffalo.

Alfred P. Sloan, Jr., chairman of the board, General Motors Corp., returned to this country late in August, following a European vacation trip.

Paul G. Hoffman, president of the Studebaker Corp., has been elected a member of the board of trustees of University of Chicago, his Alma Mater. He is a member of the class of 1909, and has participated in many alumni activities. Mr. Hoffman is also chairman of the University of Chicago alumni committee on information and development.

Benjamin E. Brown, Jr., has joined the Beacon, N. Y., laboratories of the Texas Co. as experimental helper. He was formerly assistant instructor, U. S. Diesel Engineering School, Allston, Mass.

John H. Andresen, Jr., is industrial engineer in the Grasselli department of E. I. DuPont de Nemours, Cleveland. He was formerly a student at Stevens Institute of Technology.

E. P. Clarkson, Toronto, has been appointed regional representative for Hupp Motor Car Corp. in the Dominion of Canada. Mr. Clarkson was, for many years, an executive of Dodge Bros., Ltd.

Russell T. Howe
to Wright Aeronautical

Russell T. Howe has joined the engineering staff of Wright Aeronautical Corp., Paterson, N. J. He was previously an engineer in the air spring division of Firestone Tire & Rubber Co., Akron.

Hunts Russian Flyers

C. J. McFarlane, Toronto field representative, Ethyl Gasoline Corp., took part in the Arctic search for the missing Russian flyers. He made his headquarters at Aklavik, N.W.T., and added Ethyl fluid to the gasoline in cache in that territory, increasing its octane rating to approximately 87. The fluid was flown 1700 air miles from Edmonton, Calgary, and much of the gasoline treated was flown to Aklavik from caches within a radius of 400 miles. In this work Mr. McFarlane cooperated with Sir Hubert Wilkins.

Henry P. Vaughan, who was automatic choke engineer of Marvel-Schebler Division of Borg-Warner, has joined the Automotive Diesel Division of General Motors as project engineer. He will be located in Detroit.

Robert S. Kidd, formerly draftsman with Ranger Engineering Corp., Farmingdale, N. Y., has taken a similar position with the Pratt & Whitney Aircraft Co., Hartford, Conn.

Dr. George W. Lewis, director of aeronautical research, National Advisory Committee

Dr. George W. Lewis
Attends Air Conference

for Aeronautics, was one of five delegates representing the United States at the Inter-American Technical Aviation Conference, held at Lima, Peru, Sept. 16. He sailed from New York on Sept. 4 and expects to return early in October.

N. W. Eveleth is sales engineer and Detroit representative for the Hoof Products Co. He had previously held a similar position with the Monarch Governor Co.

Charles A. Cole, formerly Detroit district manager for Thompson Products, Inc., has been promoted to the position of western division sales manager, in charge of sales in states west of the Mississippi.

Ellis W. Templin, automotive engineer, Los Angeles Department of Water and Power, has been elected secretary of the Los Angeles Automotive Council, an organization of fleet operators.

Past-Presidents in Europe

Past-President and Mrs. D. G. Roos, with young daughter, sailed on the *Aquitania,* Sept. 16, for a four-month sojourn in England. Mr. Roos is doing automotive consulting work for Humber, Hillman, Talbot and Sunbeam, parts of the Rootes motor combine. While abroad Mr. Roos, who is technical advisor to the Studebaker Corp., plans to attend the European automobile shows.

Past-President Charles F. Kettering, vice-president of General Motors Corp., and Mrs. Kettering, sailed on the liner *Normandie* on the fifteenth of last month.

(*Continued on page 25*)

News of the Society

October Sees Section Programs in Full Swing

This month finds SAE Sections getting down to serious business. Vacations are over – most Fall outings and golf parties were held last month – and members are anxious to attend technical programs that will keep them up to date on happenings in the industry.

SAE President Harry T. Woolson will visit the far-Western Sections of the Society. On Oct. 4 he will meet with the Denver SAE Club. From there he will go to Los Angeles to attend the National Aircraft Production Meeting and see members of the Southern California Section. The Northern California Section will be host to Mr. Woolson in Oakland at its Oct. 11 meeting; and he will be welcomed in Portland by the Oregon Section on Oct. 14 and in Seattle by the Northwest Section on Oct. 15. SAE Secretary and General Manager John A. C. Warner will accompany him on his visits to the Pacific Coast Sections.

Eastern Sections have interesting programs lined up. Ernst Esch, who founded the Institute for Traffic Matters at the University of Cologne, Germany, will talk on the motorization of his country at the Metropolitan Section's Oct. 14 meeting. He will have with him 20 students who are in the United States to study traffic conditions. Detroit has two October meetings scheduled and up in Canada the Canadian Section will hear W. F. Bird, of Collins & Aikman Corp., speak on textiles used in automobiles. Joseph Geschelin, of *Automotive Industries*, will give the Southern New England Section a preview of 1938 automobile design.

These are but samples of the programs in store as SAE Sections get into high gear for 1937-1938.

Sports Popular at Fall Social Meeting

● Metropolitan

Nearly 200 members and their guests attended the Fall social meeting of Metropolitan Section, Sept. 14, at Pelham Country Club, Pelham Manor, N. Y., most of them for the all-day outing. Golf, tennis, bowling, swimming, and bridge for the women guests were planned by J. F. Creamer, chairman of the event, and a dinner dance closed the affair long after midnight.

A demonstration of Red Cross life saving was put on by a team under Capt. David J. Yates, director of the organization's first aid and life saving activities.

Among the guests introduced following the dinner were John A. C. Warner, secretary and general manager of the Society; Alfred Reeves, vice-president and general manager of the Automobile Manufacturers Association; B. F. Curry, president of B. F. Curry, Inc., and his guest Babe Ruth; and Harry Bragg, manager of the New York Automobile Merchants Association.

Furber Marshall served as master of ceremonies in making the introductions and awarding the scores of elaborate prizes won during the day. His performance was a highlight of the meeting, and a challenge to many professional entertainers.

Chairmen serving under Mr. Creamer were C. Eustace Dwyer, golf; George W. Kuhlman, swimming; Mrs. Walter Peper, bridge; Merrill C. Horine, bowling, and Sid. G. Harris, tennis.

Field Editors

Baltimore – **Espy W. H. Williams**
Buffalo – **G. W. Miller**
Canadian – **Warren B. Hastings**
Chicago – **Austin W. Stromberg**
Cleveland – **William G. Piwonka**
Dayton – **Mearick Funkhouser**
Detroit – **William F. Sherman**
Indiana – **Herman Winkler**
Kansas City – **No Appointment**
Metropolitan – **Leslie Peat**
Milwaukee – **Theodore L. Swansen**
New England – **J. T. Sullivan**
No. California – **C. W. Spring**
Northwest – **R. J. Hutchinson**
Oregon — **J. Verne Savage**
Philadelphia – **H. E. Blank, Jr.**
Pittsburgh – **Murray Fahnestock**
St. Louis – **C. T. Schaefer**
So. California – **W. G. Chamberlin**
So. New England — **F. W. Mesinger**
Syracuse – **No Appointment**
Washington – **Capt. E. L. Cummings**

Man Power Aids Horsepower

When it comes to negotiating a 21 per cent grade over rough country with a 155-mm. mortar in tow, 19 men are called upon to help an army truck with its overload. This picture was snapped in the hills of Hawaii by Maj. Walter C. Thee, Q.M.C., chief, transportation division at Schofield Barracks, T. H. He has supervision of 1200 motor vehicles at that post and the handling of some 36,000,000 lbs. of rail shipments annually.

SAE Handbook Gets Accolade of 40 States

From motor-vehicle commissioners and highway officials in 40 states during the last 30 days has come evidence of the value and importance of the SAE HANDBOOK in state regulatory and inspection work.

Copies of each new yearly edition of the HANDBOOK have been sent to these officials in all states, District of Columbia and Province of Ontario, Canada, in each of the last two years but the response to the 1937 edition is more direct and vigorous than ever before. Extra copies for the personal use of additional officials have been requested in more than a dozen states.

Part of the increased interest in the HANDBOOK undoubtedly is due to what West Virginia's Transportation Supervisor James P. Tierney refers to as "the present trend of motor-vehicle legislation to give additional attention to questions of construction and equipment. The SAE HANDBOOK," he continues, "is most helpful."

Similar specific assurances of the usefulness of the volume to these public officials come in such statements as: "It would be a great convenience to me if I could have a copy of my own" from W. L. Cross, chief engineer of the Connecticut Department of Motor Vehicles. . . . "We have found your SAE HANDBOOK of valuable assistance during the past year," from Assistant Director Frances J. Buckley of the Delaware Motor Vehicle Department. . . . "The SAE HANDBOOK which we receive each year has proved very useful," from Deputy Chief Inspector G. W. Zeigler of New Jersey. . . . "There is one official in this state who has great need for the SAE HANDBOOK," from Registrar Frank West of the Ohio Bureau of Motor Vehicles. . . . "I know it will be of considerable help to us," from Commissioner R. E. Hammond of Utah. . . . "We wish to compliment you on the splendid make-up of the book,"

(*Continued on page* 24)

SAE Nominees for 1938

FOLLOWING are the names of those who have been nominated as officers and members of the Council for 1938:

President . . C. W. Spicer
Vice-President, Spicer Mfg. Corp.

Treasurer . . David Beecroft
Bendix Products Corp.

Councilors

Term of 1938-1939

W. J. Davidson
General Sales Manager, Winton Engine Corp.

L. J. Grunder
Automotive Engineer, Richfield Oil Co. of Calif.

B. J. Lemon
Tire Engineer, U. S. Rubber Products, Inc.

Members of the 1938 Council will include also the following three men who were elected at the beginning of 1937 for a two year term:

A. T. Colwell
Vice-President, Engineering, Thompson Products, Inc.

W. C. Keys
Mechanical Products Engineer, U. S. Rubber Products, Inc.

J. L. Stewart
General Manager, Canadian Automobile Chamber of Commerce

Serving on the 1938 Council as Past-Presidents:

Ralph R. Teetor
Charge of Engineering, Perfect Circle Co.

Harry T. Woolson
Executive Engineer, Chrysler Corp.

Vice-Presidents

Aircraft . . . . Frank W. Caldwell
Engineering Manager, Hamilton Standard Propellers

Aircraft-Engine . . . Ralph N. DuBois
Experimental Engineer, Aviation Mfg. Corp., Lycoming Div.

Diesel-Engine . . . . Carl Behn
Sales Manager, National Supply Co. of Delaware

Fuels & Lubricants . B. E. Sibley
Chief Technologist, Continental Oil Co.

Passenger-Car . . . . Clyde R. Paton
Chief Engineer, Packard Motor Car Co.

Passenger-Car-Body . Frank S. Spring
Engineer, Hudson Motor Car Co.

Production . . . . E. N. Sawyer
Production Engineer, Cleveland Tractor Co.

Tractor & Industrial Power Equipment . C. E. Frudden
Chief Engineer, Allis-Chalmers Mfg. Co.

Transportation & Maintenance . . . . F. L. Faulkner
Automotive Engineer, Manager, Automotive Department, Armour & Co.

Truck, Bus & Railcar . . . . H. E. Simi
Chief Engineer, Twin Coach Co.

News of the Society

(*Continued from page 22*)

from Secretary of State Lester C. Hunt of Wyoming and many others. A. W. Koehler, executive secretary, American Association of Motor Vehicle Adminstrators, in a letter adds to the above comments, "You may be sure that I shall appreciate receiving this very useful reference book as succeeding editions are issued."

More Owners of E-P Lubricants Testing Machines

The following names should be added to the list of companies and laboratories purchasing the SAE E-P lubricants testing machine which was published in the SAE JOURNAL for September: The Elco Grease & Oil Co., Halowax Corp., Imperial Oil, Ltd., Shell Oil Co., Esso Laboratories of the Standard Oil Development Co., Valvoline Oil Co., and C. C. Wakefield & Co., Ltd.

Hale Heads Ordnance Advisory Committee Group

At the request of the Chief of Ordnance, United States Army, the SAE Ordnance Advisory Committee has organized a subcommittee on rubber products, according to Chairman H. W. Alden and Col. G. F. Jenks, Ordnance Department, United States Army, under whose general leadership the cooperative work of the Society with the Ordnance Department is being carried on.

Hessler Studio

Col. G. F. Jenks

Headed by J. E. Hale, Firestone Tire & Rubber Co., this group will advise upon a program of development of Ordnance rubber products of non-commercial application, and methods to secure the cooperation of the rubber industry in its execution. It will also advise upon the application of industrial developments of rubber products and technique to Ordnance materiel.

Serving with Mr. Hale on this subcommittee representing the rubber companies are: K. D. Smith, B. F. Goodrich Rubber Co., with H. Schippel as alternate; G. K. Henshaw, Goodyear Tire & Rubber Co., with R. T. Brown as alternate; and Dr. S. M. Cadwell, U. S. Rubber Products Co., Inc., with E. Botts as alternate. L. M. Kubaugh is alternate for Chairman Hale. *Representing the Ordnance Department, United States Army*, are: Lt. Col. B. O. Lewis, with W. F. Beasley as alternate; Maj. J. K. Christmas, with Capt. E. L. Cummings and H. W. Evans as alternates; Col. W. A. Capron, with Dr. A. C. Hanson as alternate; and Maj. W. W. Warner.

First Meeting Devoted to Ignition Problems

• No. California

Members and guests of the Northern California Section turned out 127 strong to open the 1937-1938 season. J. E. Echlin, president of the Echlin Manufacturing Co., the speaker of the evening, explained the use of modern equipment in locating and correcting troubles in modern ignition systems. He also told of the effect of various classes of ignition sparks on mixtures of varying densities and the effect of wear, oxidation and direction of the various elements in the ignition system.

Supplementing Mr. Echlin's paper were remarks by Clinton E. Stryker, McKinsey, Wellington & Co.

Chairman A. H. LauFer presided and opened the meeting by outlining the events in store for Northern California Section members.

SAE *Coming* EVENTS

National Aircraft Production Meeting

Oct. 7-9 Los Angeles
Ambassador Hotel

Annual Dinner

Oct. 28 New York
Commodore Hotel

Metropolitan Section Regional T & M Meeting

Nov. 9-10 Newark, N. J.

West Coast Section Regional Transportation Meeting

Nov., 1937 San Francisco, Calif.

National Production Meeting

Dec. 8-10 Flint, Mich.
Hotel Durant

Annual Meeting

Jan. 10-14, 1938 Detroit

Canadian—Oct. 20

Royal York Hotel, Toronto; dinner 7:00 P.M. Textile Manufacture and Research – W. F. Bird, director of research and technical control, Collins & Aikman Corp.

Chicago—Sept. 29 to Oct. 1

Blackstone Hotel – Section Regional Transportation Meeting. Morning, afternoon and evening sessions, starting Wednesday afternoon, Sept. 29, at 2:00 P.M. Dinner 6:45 P.M. Wednesday, Sept. 29.

Cleveland—Oct. 11

Cleveland Club; dinner 6:30 P.M. Flame Propagation – A. M. Rothrock, National Advisory Committee for Aeronautics.

Detroit—Oct. 11 and 18

Statler Hotel. Joint Junior-Student and Aeronautic Meeting Oct. 11, 8:00 P.M., with Henry G. Weaver, Consumers' Research Department, General Motors Corp., as speaker. There will be an additional speaker on an aeronautic subject. Oct. 18, dinner 6:30 P.M. At this dinner meeting, John Oswald, chief body engineer, Olds Motor Works, will speak on The Body Designer's Future.

Indiana—Oct. 14

Severin Hotel, Indianapolis; dinner 6:30 P.M. Automobile Design and Safety – John H. Hunt, director of New Devices Section, General Motors Corp.

Metropolitan—Oct. 14

The Roger Smith, 40 E. 41st St., New York City; dinner 6:30 P.M. Motorization of Germany, and the Competition between Railway and Motor Car – Prof. Ernest Esch, director of motor transport science, University of Cologne, Germany. There will be discussion by a number of eminent authorities on transportation problems.

Milwaukee—Oct. 8

Milwaukee Athletic Club; dinner 6:30 P. M. Propane Fueled Engines for Air-Conditioned Railway Passenger Cars – L. W. Melcher, manager Refrigeration Division, Waukesha Motor Co.

New England—Oct. 14

664 Commonwealth Ave., Boston, Mass.; dinner 6:30 P.M. Subject – Modern Methods of Car Reconditioning, with demonstration of reconditioning equipment.

Northern California—Oct. 11

Athens Athletic Club, Oakland; dinner 6:30 P.M. Speakers – Harry T. Woolson, executive engineer, Chrysler Corp., and president, SAE; John A. C. Warner, secretary and general manager, SAE.

Northwest—Oct. 15

New Washington Hotel, Seattle; dinner 6:30 P.M. Speakers – Harry T. Woolson, executive engineer, Chrysler Corp., and president, SAE; John A. C. Warner, secretary and general manager, SAE.

Oregon—Oct. 14

Multnomah Hotel, Portland; dinner 6:30 P.M. Speakers – Harry T. Woolson, executive engineer, Chrysler Corp., and president, SAE; John A. C. Warner, secretary and general manager, SAE.

Philadelphia—Oct. 13

Engineers Club; dinner 6:30 P.M.

Pittsburgh—Oct. 19

Hotel Webster Hall; dinner 6:30 P.M. Chemical Hay for Mechanical Horses – Robert E. Wilson, president, Pan American Petroleum and Transport Co.

Southern California—Oct. 7-9

Ambassador Hotel, Los Angeles. National Aircraft Production Meeting. (For complete program see special insert elsewhere in this issue.)

Southern New England—Oct. 26

Bond Hotel, Hartford, Conn.; dinner 6:30 P.M. What's New in New Cars – Joseph Geschelin, technical editor, Chilton Publications.

Syracuse—No Meeting

Washington—Oct. 12

Cosmos Club, Washington, D. C.; dinner 6:30 P.M. Commercial Vehicles in the Military Service. The Problem of the Quartermaster Corps – Lieut.-Col. J. H. Johnson, Q.M.C., chief, Motor Transport Branch, U. S. Army; The Problem of the Ordnance Department – Maj. John K. Christmas, Ordnance Department, chief, Automotive Section, Artillery Division, U. S. Army. There will be discussion by prominent military men and executive engineers of large automotive plants.

About SAE Members:
..*At Home and Abroad*

(*Continued from page 20*)

R. N. Janeway, research engineer, Chrysler Motor Corp., and *E. H. Kelley*, engineer, Chevrolet Motor Co., represent the Detroit Section of the Society on the Affiliate Council of the Engineering Society of Detroit. Mr. Janeway is vice-chairman of this Council.

J. H. McDuffee
Changes Headquarters

J. H. McDuffee, president, Prest-O-Lite Battery Co., has transferred his headquarters from Indianapolis, Ind., to Toledo, Ohio.

Joseph Doyle, of the technical service department, Bendix Products Corp., is conducting the Bendix-Stromberg traveling clinic which is making a nation-wide tour.

Frank M. Kincaid, Jr., has joined the Wright Aeronautical Corp., Paterson, N. J., as layout draftsman.

Robert S. Buck, formerly a student at New York University, has joined the Lockheed Aircraft Corp., Burbank, Calif.

D. E. Blair, general superintendent, Montreal Tramways Co., and *John H. Walsh*, superintendent rolling stock and shops, Middlesex & Boston Street Railway Co., are two of the four men nominated to serve for two years on the American Transit Association Bus Division Executive Committee.

William A. Heinze has been chief engineer of G. S. Blakeslee & Co., Cicero, Ill., since Sept. 1. Before that he was mechanical research engineer, Victor Manufacturing & Gasket Co., Chicago.

P. B. Rogers is eastern procurement representative of Douglas Aircraft Co., Inc., Santa Monica, Calif. He makes his headquarters at Cleveland Heights, Ohio.

Edward C. Blackman resigned his position of sales engineer of Thermoid Rubber Co., Trenton, N. J., to join Socony-Vacuum Oil Co., Inc., as commercial fleet engineer, Southeastern Division, with headquarters at Baltimore, Md.

A. J. Underwood, western advertising manager, SAE Journal, assisted in timing at the National Air Races held in Cleveland last month.

Arthur A. Pelke, who has been district service representative, Chevrolet Motor Division of General Motors Sales Corp., New York, has been transferred to St. Louis as mid-west region products representative of the same company.

Walter F. Whiteman has joined the staff of William & Harvey Rowland, Inc., Philadelphia, as spring engineer. He previously had been spring service engineer with Brodie System, Inc., Brooklyn, N. Y.

15 SAE Men on National Safety Council Program

Fifteen members of the Society are taking part in the 26th National Safety Congress and Exposition sponsored by the National Safety Council at Atlantic City, Oct. 11 to 15.

At the opening session, the annual meeting of members, Dr. Miller McClintock will speak on "Safety, Today and Tomorrow." That afternoon at the Aeronautical Session, of which Capt. E. V. Rickenbacker is chairman and Jerome F. Lederer is secretary, Richard Gazley and Walter A. Hamilton are to speak.

Paul G. Hoffman will take part in a discussion on "Drivers of the Future" at an Educational Session and Dr. A. R. Lauer will give his opinion on "What Are Fit and Unfit Drivers?" Dr. Lauer will also speak on psychological tests for operators at a Commercial Vehicle Session, and on the same program O. M. Brede will talk on preventive maintenance. At other Commercial Vehicle Sessions J. W. Lord, H. R. Grigsby and H. H. Kelly will speak.

W. S. James, appearing at a Street & Highway Traffic Session, will take as his subject, "Engineering the Vehicle for Safety." He will also participate in a discussion on night accidents.

Maxwell Halsey will talk at a session devoted to the Traffic Officers' Training School. At another session H. E. Hildebrand will tell of "Accident Reduction with a Planned Maintenance System." Charles R. Miller, at the Fire Prevention Session, will speak of handling flammable liquids.

About Authors

(*Continued from page 11*)

Volta Meeting, held by the Royal Academy of Italy, in Rome. He was born in Greeley, Colo., and after attending the Greeley Teachers' College he entered the University of California at Berkeley from which he was graduated with honor in 1924, receiving his B.S. degree in Engineering. After a short period with the Pacific Telephone & Telegraph Co. he went to the National Advisory Committee for Aeronautics at Langley Field in 1925. He is now in charge of the N.A.C.A. Variable Density Section.

• **Dr. Oscar C. Bridgeman** ***followed graduation from Harvard University in 1925 with the degree of Ph.D. in physical chemistry, with two years at M.I.T. as a National research fellow, working on thermodynamic problems. In 1927, Dr. Bridgeman became associated with the National Bureau of Standards as a research associate, working in the automotive powerplant section on fuel problems. In 1931 he was made chief of the Lubrication and Liquid Fuels Section. Since that time he has been engaged in both lubrication and fuel research. Dr. Bridgeman received the Manly Memorial Medal from the SAE in 1930 for his paper on airplane vapor lock.***

• **Miss E. W. Aldrich** ***graduated from Tulane University in 1927 with the degree of M. S. in chemistry. She joined the Automotive Powerplant Section of the National Bureau of Standards in 1928 and was transferred to the Lubrication and Liquid Fuels Section in 1931. She has been engaged principally in investigations of vapor lock both with motor and aviation fuels, gum in gasoline, alcohol fuels and, more recently, in the stability of aviation lubricants.***

• **George Jackson Mead** ***joined with F. B. Rentschler in 1925 to form the Pratt & Whitney Aircraft Co. Then as vice-president and chief engineer of that company he was responsible for the design of the first "Wasp" engine, the most powerful air-cooled engine of that time, and directed continued developments of Pratt & Whitney powerplants. In 1929 he was made vice-president of the United Aircraft & Transport Corp., and, in 1934, vice-president and chief engineer of United Aircraft Corp. After attending the Massachusetts Institute of Technology, Mr. Mead first entered the aircraft field in 1917 as experimental engineer with the Wright-Martin Aircraft Corp. Leaving there in 1919 he spent one year as engineer in charge of the powerplant laboratory of the United States Air Corps at Dayton, before joining the Wright Aeronautical Corp. as chief engineer. He left Wright in 1925 to help form the Pratt & Whitney Aircraft Co.***

Herman Diederichs

Herman Diederichs, Dean of the College of Engineering and chairman of the board of athletic control at Cornell University, died at Clifton Springs Sanatorium, Aug. 31. He was 63 years old.

For 44 years Dean Diederichs had been identified with Cornell University as student, teacher and, since July of last year, as dean of the engineering college. He was regarded as an authority in experimental engineering with special reference to materials of engineering. His textbook, in collaboration with the late Prof. R. C. Carpenter, published in 1910, is standard in its field. With W. C. Andrae, he was co-author of a work on mechanical experimental engineering, published in 1931. He became a member of the SAE in 1921.

Dean Diederichs was born at Muenchen-Gladbach, Germany, and came to this country with his parents in 1888, settling in Dolgeville, N. Y. He attended high school there and won the state scholarship to Cornell in 1892. He was graduated with an M.E. degree in 1897. In his senior year he won the first Sibley prize and the Sibley Fellowship for graduate study. After a year on this fellowship he was appointed to Cornell's faculty.

Charles S. McIntyre

Charles S. McIntyre, president of the Monroe Auto Equipment Co. since 1923, died on Aug. 26. He had been a member of the SAE for nine years.

Mr. McIntyre started in the automotive equipment manufacturing business in 1917 after having been one of Michigan's pioneer automobile dealers. At that time, with three associates, he incorporated the Brisk Blast Manufacturing Co., of which he became vice-president in 1918. The following year the name of the firm was changed to the Monroe Auto Equipment Co., and four years later Mr. McIntyre was elected president. He was born in New York in 1878.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Aug. 15, 1937, and Sept. 15, 1937.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

AGERELL, WILLIAM C. (M) chief engineer, Pines Winterfront Co., 1135 N. Cicero Ave., Chicago, Ill.

AUSTIN, PAUL M. (A) superintendent, marketing, motor transport, Pure Oil Co., Post Office Box 239, Houston, Texas.

BAIRD, JOHN H. (J) retail sales manager, Lubri-Zol Corp., Box 3057, Euclid St., Cleveland, Ohio (mail) 1885 Lampson Road.

BURGIE, F. W. (M) chief engineer, Doehler Die Casting Co., Smead Ave., Toledo, Ohio.

BYERS, ROBERT DAVID (J) air engineer, Hamilton Aero Club, Hamilton, Ontario, Canada.

CRAIG, BRUCE K., JR. (J) aeronautical engineer, American Airlines, Inc., 5036 W. 63rd St., Chicago, Ill. (mail) 156 N. Oak Park Ave., Oak Park, Ill.

EBINGER, ADAM (M) superintendent of garages, St. Louis Public Service Co., 3869 Park Ave., St. Louis, Mo.

EDDY, W. P., JR. (M) metallurgical and service engineer, Yellow Truck & Coach Mfg. Co., Pontiac, Mich.

FRASER, DONALD MCLEOD (A) partner, Peerless Engrg. Co., 11 Charlotte St., Toronto, Ontario, Canada.

HOLLÓS, ZSIGMOND (F M) designer, Spittelauerlande 13, Wien, IX, Austria.

KENNEDY, VERNE C. (M) executive vice-president, Truck Leasing Corp. of America, 2917 S. Wabash, Chicago, Ill.

KNIGHT, HENRY H. (A) assistant to vice-president, Henry H. Knight Co., 333 N. Michigan Ave., Chicago, Ill.

LAFAYE, H. J. (A) sales, Goodyear Tire & Rubber Co., Inc., Rim Div., Akron, Ohio (mail) 584 Moreley Ave.

MILLER, DAVID C. (J) Welker Machinery Co., New Center Bldg., Detroit, Mich. (mail) 1418 E. Lincoln Ave., Royal Oak, Mich.

PIAGGIO, ENRICO (F M) director, Soc. An. Piaggio & C., Via Petrarca, 2-12, Genova, Italy (mail) Soc. An. Piaggio & C., Pontedera (Pisa), Italy.

ROSELLO-DUHAGON, FRANCISCO (A) general inspector, Machinery Dept., Banco Nacional de Credito, Ejidal S. A., V. Carranza St., Mexico City, Mexico (mail) Guadalajara No. 59, Dep. 3, Mexico, D. F.

RUPP, ARTHUR W. (A) division supervisor, buildings, supplies and motor equipment, Illinois Bell Telephone Co., 212 W. Washington St., Chicago, Ill. (mail) 215 W. Randolph St.

SMITH, JAMES M. (M) instructor, Dept. of Mech. Engrg., Rensselaer Polytechnic Inst., Troy, N. Y. (mail) 519 Third Ave., N.

STRAWN, HARVIE H. (A) assistant transportation engineer, European Sales Office, International Harvester Export Co., 606 S. Michigan Ave., Chicago, Ill. (mail) 1 Place Stephanie, Brussels, Belgium.

SUESS, FRANK A. (A) assistant to chief technician, Continental Oil Co., Ponca City, Okla. (mail) 200 S. Palm St.

SWAN-FINCH OIL CORP. (Aff.) 30 Rockefeller Plaza, Room 1605, New York City. Rep: McQuillen, Emmett M.

WACHSMUTH, ERNST E. (M) technical advisor, Revere Copper & Brass, Inc., 5851 W. Jefferson, Detroit, Mich.

WALTON, WILLIAM L. (A) field engineer, Young Radiator Co., Racine, Wis. (mail) 1831 N. Erie St.

Applications Received

The applications for membership received between Aug. 15, 1937, and Sept. 15, 1937, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

ALLEN, W. H., division manager, National Refining Co., Cleveland, Ohio.

BALLUDER, ERWIN, manager, western division, Pan American Airways, Brownsville, Texas.

BOWMAN, RICHARD G., engineer, Seversky Aircraft Corp., Farmingdale, L. I., N. Y.

CALEEN, REYNOLD L., flight engineer, United Air Lines Transport Corp., Chicago, Ill.

CAMPBELL, JOHN M., research engineer, General Motors Corp., Detroit, Mich.

CARO, RAMON, president and general manager, Ramcar, Inc., Manila, Philippines.

DEDO, HOMER H., engineer, Ethyl Gasoline Corp., Detroit, Mich.

ENGELMAN, ROBERT CHARLES, engineer in charge of development work, S. R. Dresser Mfg. Co.-Clark Bros. Co., Olean, N. Y.

FENN, EDWARD H., project engineer, Pratt & Whitney Aircraft Division, United Aircraft Corp., E. Hartford, Conn.

FRICHOT, BERT C., chief chemist, Deep Rock Oil Corp., Cushing, Okla.

GRUSH, MARVIN DWIGHT, auto mechanic, U. S. Marine Corps, San Francisco, Calif.

GUIOU, ELTY C., motor vehicle supervisor, New England Tel. & Tel. Co., Boston, Mass.

HARGER, GEORGE HOWARD, manager, lubricants sales, Northern California Division, General Petroleum Corp. of California, San Francisco, Calif.

HOBEIN, KINGSLAND, engine tester, Wright Aeronautical Corp., Paterson, N. J.

HAYES, WILLIAM M., district manager, Air Reduction Sales Co., Detroit, Mich.

HERMSEN, B. A., superintendent of transportation, Nebraska Power Co., Omaha, Nebr.

HOWELL, CARLTON E., sponsor engineer, Ebasco Services, Inc., New York City.

HUXTABLE, RICHARD S., production department, Winton Engine Mfg. Corp., Cleveland, Ohio.

JAMES, JOHN A., instructor, Delehanty Institute, New York City.

JOHNSON, LIEUT. COL. JAMES H., chief, Motor Transport Branch, Office of the Quartermaster General, Washington, D. C.

KALLONECK, LOUIS HENRY, shop cost manager, United Parcel Service, New York City.

KASEM, MOHAMED RADWAN, lubrication engineer, Mechanical Transport Garage, Ministry of Communication, Cairo, Egypt.

KENDALL, GEORGE H., service engineer, Norma-Hoffmann Bearings Corp., Stamford, Conn.

KING, LESLIE WILLIAM, technical representative, Clayton Dewandre Co., Lincoln, England.

LESLIE, ARTHUR, works manager, Royal Indian Army Service Corps, Bannu, N.W.F.P., India.

LITTLE, WILLIAM F., engineer, Electrical Testing Laboratories, New York City.

MACNAUGHTON, ERNEST J., detailer, Packard Motor Car Co., Detroit, Mich.

MANN, W. L., civil officer, technical department, Army Air Corps, Dutch East Indies Army, Bandoeng, Java, D.E.I.

MANTHEY, LARRY, sales engineer, Allen Electric & Equipment Co., Kalamazoo, Mich.

MILLER, J. J., automotive engineer, General Petroleum Corp. of California, Seattle, Wash.

MORRIS, DONALD W., experimental engineer, Twin Disc Clutch Co., Racine, Wis.

MOXEY, JOHN G., JR., laboratory assistant, automotive engine laboratory, Sun Oil Co., Marcus Hook, Pa.

NAGLE, THEODORE H., director service engineering, United Motors Service, Inc., Detroit, Mich.

NICHOLAS, DONALD Y., promotional manager, D. G. Nicholas Co., Scranton, Pa.

PAXTON, CHARLES N., associate professor, University of Oklahoma, Norman, Okla.

POBJOY, DOUGLAS RUDOLF, chairman, managing director and chief engineer, Pobjoy Airmotors Co. Ltd., Rochester, England.

PURVIN, BENJAMIN ROBERT, engineer, machine tool division, Barber-Colman Co., Rockford, Ill.

REZNEK, LOUIS, junior mechanical engineer, Section of Safety, Bureau of Motor Carriers, I.C.C., Washington, D. C.

RICKENBACH, A. W., experimental engineer, Lycoming Mfg. Co., Williamsport, Pa.

ROEBER, ERNEST M., draftsman, Godfrey Mfg. Co., New Brunswick, N. J.

RUTLAND, ARTHUR GOULD, owner and manager, A. G. Rutland, Nelson, New Zealand.

RYAN, WILLIAM J., sales department, Fageol Truck & Coach Co., Oakland, Calif.

SCOTT, VERNON L., sales engineer, W. H. Barber Co., Minneapolis, Minn.

SEEHOLZEN, LEON, chief mechanical engineer, S.C.O.A. Aba, Nigeria, West Africa.

SHERMAN, L. L., traffic supervisor, Iowa-Nebraska Light & Power Co., Lincoln, Nebr.

SMITH, H. S., sales manager, Burgess-Norton Mfg. Co., Geneva, Ill.

SMITH, YEATMAN W., automotive engineer, Sinclair Refining Co., Chicago, Ill.

SWARTZELL, K. L. R., fleet service manager, Shanghai Power Co., Shanghai, China.

TASKER, DONALD K., sales, White Motor Co., Boston, Mass.

TOMAN, PHIL F., division lubricating engineer, General Petroleum Corp., Seattle, Wash.

UHRICH, HAROLD R., design engineer, Sensenich Brothers, Lititz, Pa.

WHITFIELD, RANDOLPH, supervisor, automotive equipment, Georgia Power Co., Atlanta, Ga.

WIEST, JOHN R., field engineer, International Harvester Co., Chicago, Ill.

WOODWARD, GEORGE H., manager, George H. Woodward, San Francisco, Calif.

WRIGHT, EARL E., motor truck sales, International Harvester Co., Denver, Colo.

Huge New Market Visioned at SAE Regional Tractor Meeting

A MARKET of 4,000,000 new farm customers will follow the development of a light, fast, inexpensive tractor, predicted Harry C. Merritt, chairman of the executive committee, Farm Equipment Institute, in his paper: "Some Problems That Are of Interest to the Farm-Machinery and Rubber Industries," presented at the dinner of the SAE Regional Tractor Meeting, held in Akron, O., Sept. 15 to 17. Such a tractor, he added, will put the small farm of 100 acres or less on a competitive basis with the large farms of the Northwest.

Over 300 engineers and executives of the tractor and rubber industries attended the dinner held in connection with the September meeting of the Cleveland Section of the SAE, at which Mr. Merritt was the principal speaker.

In addition to Mr. Merritt's discussion, nine other papers were presented at the Meeting in sessions devoted to tractor and implement tires, wheels and rims, welding, and tractor-tire testing. Visits to rubber and rim plants of Goodyear, Goodrich, and Firestone, and the Goodyear-Zeppelin dock, equipment demonstrations, and tractor-tire tests gave first-hand, visual information on these vital topics to supplement that of the papers.

Three Rubber Company Presidents Speak

With cooperation between the rubber and tractor industries as the keynote of his address at the dinner, S. B. Robertson, president, B. F. Goodrich Co., strongly stressed the standardization of sizes of tractor tires as one of the most important factors in the reduction of the price of tractor tire equipment.

Twenty-five per cent of the people in the United States live on farms and are entitled to the comfort, economy, and profit which will come to them through the mechanization of the farm, stated J. W. Thomas, president, Firestone Tire and Rubber Co., in another address. This mechanization can come to them only through the use of the farm tractor, the maximum development of which depends upon the use of rubber tires, Mr. Thomas pointed out.

P. W. Litchfield, president, Goodyear Tire and Rubber Co., spoke along a similar vein when he stated that the drift of population has been from the farm to the city but, with the advent of inexpensive tractor power and a continuation of the tremendous development of the use of power on the farm, it can be but a short time before this trend is reversed. The city dweller has had the greatest advantage of the application of power to industry, he explained, since the farmer has been in no position to magnify his production as was being done by the factory. He showed clearly how the tide has turned due to the development of the rubber-tired tractor during the past five years.

Interest of industry in farm problems was held to be the keynote of all three speakers for the rubber companies.

Mankind always has attempted to travel farther, faster, safer, and more luxuriously. Most of our problems have been built up around transportation. The pulling of wheeled vehicles is one of man's oldest problems. In the old days, the founders of our country worked every daylight hour to provide food for their families. Most of us have seen the hours of labor drop from ten or eleven a day, six or seven days a week, to a five-day week of eight hours each. All of this represents progress, and the automotive industry has always been one of the leaders in this respect, contended SAE President Harry T. Woolson, in a short talk on this theme in which he stressed the international scope of the Society and its importance in the developments being made in raising the standard of living. The Tractor Activity in itself shows the scope of our industry, he pointed out, coupling as it does, major problems of the diverse fields of rubber, Diesels, fuels, and automobiles with man's oldest industry, farming.

J. E. Hacker, Winton Engine Corp., presided at the dinner; V. R. Jacobs, Goodyear Tire and Rubber Co., acted as toastmaster, and A. T. Colwell, Thompson Products Co., was sponsor.

The entire program of the Tractor Meeting was characterized by an enthusiastic and energetic spirit. Credit for the success of the entire series of meetings was given to the meeting's committee, directed by E. F. Brunner, of Goodyear, and C. G. Krieger of Ethyl Gasoline Corp., with the cooperation of the Firestone, Goodrich, and Goodyear rubber companies.

Prominent Speakers Feature Tractor Meeting Dinner

Presidents of Akron's three largest rubber companies and farm equipment executive address 300 at dinner. (*Left to right*) H. C. Merritt, chairman, Executive Committee, Farm Equipment Institute; P. W. Litchfield, president, Goodyear Tire and Rubber Co.; S. B. Robertson, president, B. F. Goodrich Co.; and J. W. Thomas, president, Firestone Tire and Rubber Co.

Characteristic of the entire series of meetings were the animated discussions which indicated the interest and the many problems existing in the application of rubber tires to farm equipment.

Tractor Testing Session

Cooperative tests to determine the efficiency of various tire sizes carried out in 1936 by a committee, of which E. F. Brunner was chairman, which was appointed by the SAE Tractor and Industrial Power Equipment Activity, were reported in the paper by R. P. Gaylord, of Goodyear, at the Tractor Testing Session. Mr. Gaylord headed the crew which conducted the tests reported in the paper. Six types of soil conditions were tested, four in the vicinity of Phoenix, Ariz., and two in the vicinity of Sterling, Ill., he stated.

At the time this program was first conceived, Mr. Gaylord went on, the tractor industry had manufactured just enough rubber-tired tractors to discover that there were a lot of questions that needed answering. At that time the majority of rubber-tired tractors were built primarily for steel wheels and rubber tires were merely optional equipment, he explained. There was still a difficult problem in choosing the correct tire size from the large number of sizes available, he pointed out. He showed that this was then a serious problem and was confused further by the inconsistency of manufacturers' data and conflicting reports from the field.

In summarizing, Mr. Gaylord stated that the major problem with rubber-tired tractors is that of securing traction for heavy loads. He told how this traction can be obtained by weighting down the drive wheels, or by decreasing the drawbar pull. The other and perhaps more logical solution to the problem lies in increasing the speed and decreasing the drawbar pull, thus utilizing the full horsepower and obtaining a greater amount of work per hour, he suggested. In other words, he pointed out that the steel-wheel tractor is a low-speed, high-pull machine, whereas the rubber-tired tractor is a high-speed, moderate-pull tractor. With the trend toward light and more moderately priced tractors, Mr. Gaylord argued, this second alternative seems the only answer in view of the fact that the light-weight tractor has an initial disadvantage in rolling resistance in soft soil.

Definite conclusions resulting from this test were given by Mr. Gaylord as follows:

(1) The most important factor affecting the coefficient of traction or tire thrust of rubber-tired tractors is the nature of the soil.

(2) For a given soil, the important factor affecting the drawbar pull of the rubber tire is the weight that it carries.

(3) Inflation pressure is relatively unimportant, lower pressures being better on loose, sandy soils.

(4) For any given size, the coefficient of traction increases slightly with the load.

(5) For a given load and section, tires having a larger rim diameter have a slightly higher coefficient of traction.

(6) Increase of traction with increase of section is negligible, other factors being constant.

(7) Rolling resistance is quite high in soft soils, building up rapidly with light loads, but increasing only a little over the range of normal tractor weights.

(8) Speed in itself has no effect on the traction developed by a rubber tire, up to at least 4 m.p.h.

(9) Equal weights applied to the wheel, or as water in the tires, produce equal additional traction.

(10) Tractors with high horsepower-to-weight ratios have to travel faster to utilize their available horsepower, or use added weights to operate at lower speeds.

A new and ingenious method of testing the slip of tractor tires by means of a moving-picture camera that is most economical of time and labor and gives a graphic picture in a permanently recorded form, was described by A. W. Bull and M. K. Jessup, both of U. S. Rubber Products Co., in their paper: "Another Method for Testing Tractor Tires," that concluded the session. This method created much discussion and was felt to have many advantages over conventional methods.

Tractor and Implement Tire Session

Considerable interest was aroused by two papers presented by J. G. Kreyer, Firestone Tire and Rubber Co., at the Tractor and Implement Tire session, describing some of the special conditions affecting tractor tire life, and some special uses of the tires. Wheel loading, he said, was especially important as affecting the life of the tires. Satisfactory tire life is based primarily upon a maximum permissible vertical deflection, the maximum amount being 20 per cent of the sectional diameter of the tire. Deflections greater than this, he warned, will have a detrimental effect on the cords of the tire body, resulting in diagonal breaks or impact breaks. The diagonal break is often the combined effect of tractor torque and overload, or underinflation, he explained, resulting in a folding in the sidewall of the tire, which fatigues the cords and causes localized separation. The impact break, or penetration break as it is termed in agricultural work, is caused primarily by insufficient tire size or overload and underinflation, he added.

Although the trend is toward the use of cast wheels that are heavier than spoke-type wheels, Mr. Kreyer showed how the practice of using added wheel weights on the rear wheels is necessary in order to secure the maximum draft. By increasing the inflation pressure accordingly, he explained how an improvement in traction and reduction in wheel slip is obtained with a consequent reduction in tread wear. The speaker believed that from 10 to 16 lb. per sq. in. inflation pressure is most satisfactory. This amount, he pointed out, gives low ground pressure and minimizes packing of the soil and ground ruts, gives maximum ground contact for greatest traction and flotation, results in satisfactory cushioning, minimizes vibration, and gives best all-around operating conditions.

Also, he added, higher pressures are more necessary in front tires than in the rear to give lateral stability in turning. High pressures in tractor tires are permissible only for use of storage and shipment, Mr. Kreyer cautioned, and under no circumstances are to be used in operation. He showed how this practice takes care of loss of pressure due to natural seepage of air through the walls of the tubes, and is only an alternative to blocking up the machine to free the tires of load.

Regarding puncture hazards encountered where corn or cotton stalks cannot be avoided, or in citrus groves where thorns are a problem, puncture-proof tubes should be used, he specified, suggesting that six-ply instead of four-ply tires often help in this case, due to their increased thickness.

Because of the varied nature of the work that tractor tires are expected to perform, Mr. Kreyer believes that the tire design must in all cases be a compromise, making prominent the feature most required. Where traction is most important, as in cane fields, he explained, a design is required that will not ball up with mud and straw, and which will be suitable for highway travel. In sandy and muck conditions, where increased traction and flotation are required, oversize tires can be used to advantage, he stated.

Liquid weight in farm tires as a means of increasing traction also was discussed at length by H. W. Delzell, B. F. Goodrich Co., in the session's second paper called: "Water in Tractor Tires." The common practice of doing this in the past – to bolt cast iron weights to the wheels – was cumbersome and rather costly, he recalled. By the use of a calcium-chloride solution, inserted in the tire with special, but com-

SAE Group Inspecting the Rim Plant of the Goodyear Tire and Rubber Co.

More than 125 took advantage of the opportunity to visit this plant, one of many inspection trips taken during the meeting

paratively simple, equipment the same effect can be obtained in a more advantageous manner, he stated. That the use of liquid in tires instead of the use of wheel weights reduces the bounce of the tractor on rough ground, lowers the center of gravity, gives better starting and acceleration, eliminates iron weights which can work loose or project beyond the tires or the hub, and is less awkward to handle than the wheel weights was Mr. Delzell's conclusion.

Wheel and Rim Session

Since the development of the low-pressure tractor tire in 1932, John H. Ploehn, French & Hecht, Inc., reported in his paper: "The Design, Production, Factory Handling, and Transportation of Tractor and Implement Wheels," that the progress of wheel development has been decidedly rapid, and the success of wheels equipped with pneumatic tires in this industry has been largely due to the early experimental work and the background of 50 years of the manufacturing of correctly designed and economically manufactured steel wheels. Mr. Ploehn's paper was the first of three presented at the Wheel and Rim Session.

In an interesting discussion reviewing past practices and describing thoroughly the present state of the art, J. G. Swain, Goodyear Tire and Rubber Co., in a paper entitled "Farm Tractor and Implement Problems," said that present rim specifications have largely been written by the tire engineer. The 5-deg. bevel on the under side of the tire bead has definitely eliminated the use of the flat rim base as is generally used in the truck industry, he pointed out. Since this type of bead was used on passenger car tires, he told how the industry set up a rim program similar to that used for passenger cars, with established dimensions for a full set of drop-center rims. This appeared to be the most rational program, he recalled, as the smaller tires for the tractors were generally similar in design and construction to passenger-car tires which are mounted on full drop-center rims.

As development progressed, he explained how this plan was greatly modified. The difficulty of removing the tires from the rims, the increase in the number of plys, and the consequent more rigid bead construction, along with the early necessity of tightening the fit of the bead in order to prevent slippage, he enumerated as contributing to the necessity of revising the type of the rim. This revision was done, and we now have the semi-drop-center rim with the detachable side ring, he announced.

With the development of tractors and farm implements, the matter of unsprung weight is not the factor that it is on the automobile and truck, he stated. The slower operating speed permits the engineer to take certain liberties which cannot be taken with higher speed equipment, he pointed out. The fundamentals of sound and correct rim construction were given as strength, simple design, ease of operation, and minimum weight.

One feature exists on tractor equipment which is not encountered on either passenger cars or trucks, Mr. Swain remarked, that is, the necessity of changing tread width for crop cultivation. It is a simple matter to build full-felloed wheels and demountable rims which will permit this change, and at the same time solve a number of other problems, he explained. With them, the tractor can be stored and shipped without tire equipment or rims, and also the machine can be painted without disfigurement of the tire, Mr. Swain concluded.

The close cooperation which has made progress possible was brought out particularly well in the third paper of the Wheel and Rim Session by C. L. Wenzel, president, Tire and Rim Association, when he outlined the founding of the Association 35 years ago, when the rubber industry realized that greatest benefits could be had only if all tire manufacturers standardized their products.

Welding Session

Electric spotwelding, a process of great importance to the manufacturer of wheels and rims, is dependent upon three fundamental factors according to S. M. Humphrey, Taylor-Winfield Corp., in his paper before the Welding Session. He named these factors as the heating of the material by the contact resistance of the surfaces, the pressure applied, and time of application of the current. Methods used at present were outlined as manual control, the use of contactors energized by cams, and the use of mechanical and electronic timers. The electronic timer in particular is accomplishing marvels in accurate split-second timing of extremely heavy currents, Mr. Humphrey believes. By this means, the author reported, after outlining the principles and methods of spot, seam, flash and shot welding, that production methods are undergoing many fundamental changes that are far-reaching in their economies. To supplement and illustrate his talk, Mr. Humphrey showed slides and moving pictures of welding equipment, both stationary and in operation.

S. A. E. Papers in Digest

HERE are digests of papers presented at various meetings of the Society.

Some of these papers will be printed in full in the S.A.E. JOURNAL.

Mimeographed copies of *all papers received* will be available, until current supplies are exhausted, at a cost of 25 cents per copy to members; and at 50 cents per copy to non-members, plus 2% sales tax on those delivered in New York City. Orders for mimeographed copies must be accompanied by remittance and should be addressed to Sessions Secretary, Society of Automotive Engineers, 29 West 39th St., New York.

Detroit Section Papers

March 30, 1937

Sleeper Buses and Their Functional Design – *George McCarroll, vice-president, Sleeper-Coaches, Inc.*

RECENT expansion of intercity bus travel and stabilization of the operating companies are reviewed, and the increased comfort of the latest bus equipment is stressed.

The sleeper bus is seen as the next logical step in coach development, especially for long runs. The influence on design of legal space limitations is pointed out, as are the disadvantages of the earlier Continental designs of sleeper buses.

The remainder of this paper discusses a sleeper bus constructed of magnesium alloy with a Pullman type of arrangement that seats 32 and sleeps 24.

April 12, 1937

Textile Manufacture and Research – *W. F. Bird, director of research and technical control, Collins & Aikman, Inc.*

THREE phases of the control of quality and improvement of automobile upholstery fabric, as indicative of the progress that the textile industry has made over the past few years, are selected for special consideration in this paper: control of quality, control of color, and building of fabric.

As an introduction to the main part of the paper, the different machines and processes used in the textile worsted yarn industry are described briefly, including sorting raw material, scouring, carding, combining, drawing, and spinning.

The system of quality control described rests upon three basic principles: (1) Elimination of all "prima-donna" and "grand-stand" players and the substitution of intelligent, progressive, and cooperative production management; (2) manufacturing specifications, and (3) rigid inspection.

From the standpoint of dyeing of automobile upholstery material, three methods are discussed: stock dyeing, yarn dyeing, and piece dyeing—and their advantages and disadvantages are evaluated.

Six requirements are set forth for the ideal automobile upholstery fabric: (1) Long life and the ability to take hard wear; (2) maximum style and beauty for luxurious and smart trim effects; (3) ease of handling; (4) elasticity and softness for comfort; (5) ventilation for dissipation of body and interior heat; (6) maximum resistance to spotting and ravages of accumulated road dust and dirt.

Northern California Section Papers

April 13, 1937

Tractor Air-Cleaner Performance in Dust Clouds – *F. A. Brooks, associate agricultural engineer, University of California.*

TO assist in evaluating the magnitude of the problem of tractor air-cleaner performance in clouds of dust raised by equipment moving dirt, a catch of ½ pt. per hr. is quoted as being often found with tractors working with graders. As the surface-soil particles lifted and carried in dense clouds by strong winds in dust and sand storms are generally much larger in size than machine-raised dust floating higher than 4 ft., the only special design problems for air cleaners to be used in dust storms are cited as those that concern rapid removal and large holding capacity.

This paper discusses design and servicing problems of oil-bath cleaners, and Cyclone or centrifugal air cleaners. For engines working in severe clouds of dust, the advantages of placing a centrifugal pre-cleaner in front of the standard oil-bath cleaner are enumerated.

Oil Filters – *Charles A. Winslow, consulting engineer.*

MODERN filtering devices for the lubricating oil of internal-combustion engines are described in this paper, after a review of their development. To more clearly set forth the requirements of filtering devices, the problems involved are set forth. The effect of these requirements, such as ease of servicing, on producing modern designs of oil filters is pointed out by means of specific examples.

Northwest Section Papers

April 16, 1937

A New Highway Code – *Lacey V. Murrow, director, Department of State Highways, State of Washington.*

THIS paper discusses the Highway Code of the State of Washington giving particular attention to the sections pertaining to weight, size, and loading of vehicles. Generous treatment is also given to sections dealing with safety, such as lighting, brakes, safety glass, and compulsory inspection stations.

Operators of motor vehicles are asked to cooperate with the Highway Department in carrying on this work with the objective of improving the safety of the highways, safety of vehicles, and safety of other people operating on the highways.

Regulation and Safety – *H. C. Reynolds, Interstate Commerce Commission.*

THIS paper discusses safety under the Motor Carrier Act. Of the individuals, groups, and associations who sponsored the Act the author points out that one of the most important was that group who felt that here was an opportunity to take a very effective step toward obtaining a greater degree of safety on the public highways. As a result it is shown that the Act was drawn to give the Interstate Commerce Commission the power and the duty to take measures designed to promote greater safety in operation of motor carriers.

Advantages of the Act in eliminating cut-throat competition; operators without funds, experience, or proper equipment; and chiseled, fluctuating, secret, and discriminatory rates are outlined. It is shown that the Commission has been given the power to make reasonable safety rules respecting the qualifications of employees, the maximum hours of service of employees, the safety of operation of equipment, and the safety of the equipment itself.

In conclusion the author stresses the need for cooperation from the entire industry in order to make the Act succeed.

Kansas City Section Paper

April 23, 1937

Fuels for High-Speed Diesel Engines—*T. B. Rendel, Shell Petroleum Corp.*

THAT high-speed Diesel engines are more sensitive to abuse by the use of unsuitable fuels than other types is pointed out in this paper as a prime reason for designing these engines so that they are adaptable to a wide variety of fuels.

The more important qualities to be considered in the selection of Diesel fuels are listed as ignition quality, viscosity, Conradson carbon, and cleanliness, and the relation of each to satisfactory engine performance is explained. Ignition quality is considered the most important of these properties from the development point of view. Control of ignition delay is discussed in considerable detail.

What

Foreign Technical Writers Are Saying

AIRCRAFT

Trend of Air-Cooled Aero Engines—The Next Five Years

By A. H. R. Fedden. Published in *The Journal of The Royal Aeronautical Society*, August, 1937, p. 635. [A-1]

In July, 1935, the author read a paper before a joint conference of the Royal Aeronautical Society and the Society of British Aircraft Constructors, entitled, "Future Research on Air-Cooled Aero Engines." A number of the suggestions put forward in the previous paper, as being suitable subject matter for research or investigation, have been, or are in course of being, investigated by various Government departments, or interested firms in England, and the author presents herewith an addendum to the original paper, outlining the trend of a future air-cooled power plant for aircraft which would be built during the next five years.

This paper, with minor changes, is published in the TRANSACTIONS SECTION, this issue of the SAE JOURNAL, pp. 437-454.

Two-Speed Blowers

By D. L. Prior. Published in *The Aircraft Engineer*, supplement to *Flight*, July 29, 1937, p. 1. [A-1]

In order to meet the requirements of modern fighting airplanes it is necessary to provide a power unit which combines the qualities of light weight and low drag with high power, both at altitude and on the ground. These requirements, however, must not be met at the expense of fuel economy.

With a blower of the centrifugal type, the power absorbed by the unit depends on the speed at which the blower is driven and the weight of air dealt with, while the temperature rise is governed by the pressure ratio of the blower, which in turn is a function of the rotor speed. Thus the power lost to the blower, and the temperature of the outgoing air, depend on the rotor speed and are not greatly affected by throttling at the intake for a given pressure ratio.

The high take-off speeds now possible and the higher working altitudes now required, make it most desirable to improve the supercharger under take-off conditions.

The two-speed supercharger effects this improvement by combining in the one unit a supercharger designed to best advantage for take-off conditions in the low gear, together with a high gear giving the required altitude performance. Curves are included showing the relationships between rotor tip speeds and power absorbed, temperature rise, and altitude, respectively.

The author contends that the most important advantage of the two-speed supercharger is the saving in fuel that can be effected by cruising at the working altitude of the engine.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

Critical Speeds of Monoplanes

By J. Hanson. Published in *The Journal of the Royal Aeronautical Society*, August, 1937, p. 703. [A-1]

The fact that attention must be given to stiffness as well as strength in aeroplane design is now generally recognized. The author points out that the provision of adequate strength alone is not sufficient to ensure that an aeroplane is immune from such troubles as flutter, loss of lateral control due to twisting of the wing and wing divergence. While of subsidiary importance while operational speeds of aeroplanes were relatively low, the higher speeds of the modern aeroplane make such problems of direct practical interest.

Following discussion of the definition and

measurement of wing stiffness, and the useful device known as the "semirigid wing," the various critical speeds of a given monoplane are considered, each being dealt with, as far as possible, under the following headings: (1) Nature of problem, (2) Analytical solutions, accurate and approximate, (3) Experimental determination, (4) Factors influencing the problem.

Corner Losses in Ducts

By G. N. Patterson. Published in *Aircraft Engineering,* August, 1937, p. 205. [A-1]

Duct systems of various types are used on aircraft. The efficiency of the systems depends upon the losses in the duct. A corner in the duct may produce a large resistance to flow if it is not carefully designed. Research on the problem of corner resistance has been undertaken by a number of investigators. Their results show that the design of a corner is very important. In the present discussion the more significant results are summarized and some factors governing the design of an efficient corner are set forth.

Verhalten von Statischen Sonden bei Hohen Geschwindigkeiten

By Helmut Danielzig. Published in *Luftfahrtforschung,* June 20, 1937, p. 304. [A-3]

The static tube in use in connection with the determination of airplane speed was found to be unsuitable for speeds above 150 m.p.h. A new tube was developed and flight-tested and found to be usable for speeds up to 250 m.p.h. Its weight is about two and one-half times that of the old tube. For the speed range experimented with, a tube length of from 65 ft. to 80 ft. was found to be sufficient to maintain a minimum distance of about 20 ft. from the fuselage. A tube designed for a speed of 350 m.p.h. was also constructed. As the bearing and pressure element an all-metal tube was chosen.

Aircraft Performance Estimation

By C. O. Vernon. Published in *The Journal of The Royal Aeronautical Society,* August, 1937, p. 679. [A-4]

This paper is an attempt to set out the methods by which the performance is estimated for a new design.

The subject has considerable scope, and only a certain portion is covered. Following consideration of lift and drag characteristics, and airscrew characteristics, the article covers level speed and climb, range (at constant r.p.m.) and the take-off run.

Matériel et Principes d'Exploitation pour l'Aviation Transocéanique

By H. Desbruères. Published in *L'Aéronautique,* April, 1937, p. 57. [A-4]

A comparison between the French air transport in the South Atlantic and the American air transport in the Pacific shows the former to be inferior in the amount and quality of service rendered; this in spite of the fact that the subsidy from the French government is almost five times the amount per unit of distance traversed as that dispensed by the American government in the form of postal remuneration. The reason assigned is that the French transoceanic service has been designed primarily for mail, and the American for passenger transport.

The author's prediction for future developments in transoceanic aviation, including the North Atlantic, is that France will continue to be inferior to Great Britain, Germany and the United States, unless she drops her policy of concentrating on non-stop mail transport and adopts that of other countries, passenger transport, with shorter hops and regular ports of call.

La Manoeuvre des Gros Hydravions à Flot

By A. Bastide. Published in *L'Aéronautique,* March, 1937, p. 50. [A-5]

Four operations must be successfully performed if the problem of handling large flying boats afloat is to be solved: towing, hoisting, sheltering and mooring.

A flying boat is particularly difficult to tow because of its low inertia, large wing span and tendency to head into the wind. The Arman scheme of towing proposed is based on the principle that the flying boat should be kept in a position of equilibrium, the resultant of the hydrodynamic forces on the submerged portion, the aerodynamic forces on the portion above the water, and the towing force. Two cables connect the towing vessel with the flying boat. Instead of remaining parallel to each other, these cables are held out at an angle to each other by suitably controlled floats between the towed and towing craft. A polygon is thus formed, the angles of which are defined by the towing vessel, the floats and the flying boat. The system is elastic, so that variations in the tractive force are absorbed, and the angles of the polygon vary automatically with shifts in direction and force of wind and wave.

For hoisting, the Kervarrec system of a crane with longitudinal displacement at the stern of a ship, or a derrick on a float are suggested; for shelter, a floating dock or a vast covered basin, and, for mooring, a stake equipped with a ring free to move vertically, to which the bow of the hull is attached by a swivel.

BODY

The Development and Production of Automobile Body Panels

By E. Beaumont. Published in the *Journal of the Institution of Automobile Engineers*, August-September, 1937, p. 25. [B-1]

The author presents this paper as a contribution to a subject, little of which has been aired, either to the public or to technical bodies, and which, although immature, has probably made more progress in the last five years than in the preceding thirty. The author explains that this progress is partly due to the need for further selling features on automobiles, which, mechanically, have reached a marvelous standard of reliability and embrace new technical details in which the vast majority of present-day car buyers show little interest.

The article includes a brief survey of the ground covered from the first car bodies which were merely a means for keeping the elements away from the occupants to the present-day designs incorporating many stages of streamline and airflow.

Although it is acknowledged that some progress has been made, it is the considered opinion of the author – anticipating an improvement on recent advances in car design, sheet steel material, equipment and improved production and handling methods – that the procedure described in the paper will probably be obsolete in five years' time.

The development and manufacturing system described by the author is only one of many.

The author is concerned in the paper with volumes of between 50 to 100 composite bodies per day of the high-standard, medium-priced class, although the majority of the process is equally applicable to an all-steel body.

Most of the various stages described deal with general principles, but the rear-end assembly of a 25 hp. salon body of modern design is dealt with in some detail, and is typical of the class of panel under review.

CHASSIS PARTS

Quer-und Winkelbewegliche Gleichganggelenke für Wellenleitungen

By Karl Kutzbach. Published in *Zeitschrift des Vereines Deutscher Ingenieure*, July 24, 1937, p. 889. [C-1]

A brief exposition is made of the movements taking place in a propeller shaft universal joint system, and of the possibility of visualizing these movements by the use of a model. The laws relating to the movements of such systems are stated, and their application in testing various types of joint is explained. The conditions governing constant-velocity universal-joint operation are investigated in more detail, and this type is said to merit serious consideration in current automotive design, because of increasing engine speeds and chassis frame deflection. The object of the article is to contribute in building up the groundwork for further universal-joint development.

L'Envirage et la Tenue de la Route

By Maurice Julien. Published in *Journal de la Société des Ingénieurs de l'Automobile*, April, 1937, p. 252. [C-1]

A theoretical analysis is made of the deformation of a pneumatic tire at the point of contact between the wheel and the road, and the effect of this on the relative road-holding ability of front and rear-wheel drive cars deduced.

Two types of deformation are differentiated between, "envirage," or side deformation and "deroulement" or unwinding. In describing "envirage" the author states that, except when making a sharp turn or traveling in a straight path on a crowned road, an automobile progresses, crab-like, obliquely with relation to its trajectory. "Envirage" is defined as that deviation of the trajectory with relation to the plane of rotation of the wheels under the action of a transverse force. It results from a progressive and continuous deformation of that portion of the elastic body of the tire not within the area of contact with the ground. "Deroulement" is the alternate contraction and expansion of the tire preceding and following the area of contact. Both types of deformation are grouped under the term "pseudo-slipping." When the forces that tend to produce pseudo-slipping become greater than the adhesive force between tire and road, then genuine slipping takes place.

Three conclusions are drawn from the consideration of the effect of these forms of tire deformation on the road-holding ability of the car.

1. "Envirage," aside from its part in the initiation of shimmy, affects only the transverse stability of the car, and this only on curves.

2. Within the limits of perfect pseudo-slipping, no other disturbance is produced except the forward displacement of the car with relation to its instantaneous center of rotation.

3. If pseudo-slipping and slipping exist simultaneously, then (a) for a curve of a given radius, a greater steering angle must be used with a front-wheel than with a rear-wheel drive car, and (b) when slowing down on a curve, the front-wheel drive car tends to turn toward the inside, and the rear-wheel drive car to the outside of the curve. If the motive force applied is sufficient to overcome the adhesive force, then skidding takes place, which, in the case of the front-wheel drive car is stable, and in the case of the rear-wheel drive car unstable and dangerous.

ENGINES

La Combustion Détonante dans les Moteurs à Explosion

By Max Serruys. Publications Scientifiques et Techniques du Ministère de l'Air No. 103, 1937. 221 pp.; 121 illustrations. [E-1]

Six years of experimental research conducted under the auspices of the French Air Ministry constitute the basis of this volume on detonation. Its five chapters deal successively with experimental equipment and methods; the general physical characteristics of knocking and its relation to local hot-spot ignition; the influence of various physical factors on the initiation of detonation; the physical mechanism of detonation and the development of a theory of nuclear combustion, and the theoretical and practical consequences of the data and theories presented.

A new experimental tool was developed for this investigation, an optical manograph whose characteristic frequency reaches and passes 28,000 per sec. This instrument is designed on a principle similar to that of the Hospitalier and Carpentier manograph. Among the advantages claimed for it are the prevention of the losses in charge and of resonance in the connection between the combustion chamber and the recording means, the reduction to the minimum of the inertia of the moving parts, the precision of proportionality between the displacement of the membrane and the pressure, the lack of friction and play, accuracy, prevention of heating of the membrane, optical compensation, displacement of the film and the light ray directed on it proportionately to the crankshaft angles and the pressure, low damping value and the characteristic frequency of vibration, the dimensions of the diagrams and the possibility of either superimposing them or recording them separately.

Other instruments for determining various conditions of operation included those for the measurement of power; fuel consumption; inlet pressure; the temperature of air, water, oil, cylinder wall, combustion chamber, and exhaust; analysis of exhaust gas and determination of the limiting pressure of detonation.

All testing was done in engines, the choice of which was guided by two principles: to use only sturdy, easily controlled and maintained engines; and to use simultaneously engines differing widely in dimensions and operating conditions. One water-cooled and two air-cooled single-cylinder engines, and a number of multi-cylinder radial air-cooled engines with variable compression and degrees of supercharging were used.

The physical and mechanical rather than the chemical aspects of detonation were the objects of the investigation, and the method adopted was primarily the measurement of pressure as a function of crankshaft angles.

On the basis of the data obtained, the author concludes that detonation is the result of extremely rapid combustion, corresponding to the formation and propagation of a detonating wave. The formation of this detonating wave is explained by the theory of nuclear combustion, according to which the propagation proceeds from a small core of carbureted gas surrounding a point of maximum temperature in the unburned mass. If this combustion is set up in a region where the temperature gradient is high or if only a small volume of gas is affected, then the explosive wave is not formed, but a new flame front appears giving rise either to pseudo-detonation or auto-ignition.

From the practical viewpoint, the results of the investigation are said to indicate that the combustion which causes detonation is produced by a simultaneous and extremely rapid increase in pressure and temperature. For the classification of fuels and the study of their knocking behavior, new methods are proposed, based on the direct measure of the limiting pressure of detonation in the engine. The possibility is indicated of increasing the compression and the charging rate of engines, and consequently their efficiency and specific power, without the use of special anti-knock fuels, by taking all precautions to decrease the maximum temperature and the pressure reached before combustion by the portion of the charge which burns last.

La Suspension Elastique des Moteurs d'Aviation en Étoile

By Maurice A. Julien. Published in *L'Aéronautique*, March, 1937, *L'Aérotechnique* section, p. 33. [E-1]

The Dynaflex elastic mounting system for radial aircraft engines, used on the Gnome-Rhône engine, here described, differs in two respects from the Lord system: qualitatively, the supports have a much greater radial flexibility than axial elasticity, and, quantitatively, the ratio of axial to tangential rigidity is 20 to 1.

After a theoretical analysis developing the basis for the Dynaflex system, its design details are described. It consists of elastic supports arranged in a crown in a plane perpendicular to the crankshaft axis and concentric to it. Each support consists of three metal plates, the middle plate, in the center of which is fixed the engine bolt, and outside plates, solid with the frame. Rubber cushions are interposed between the middle and the outside plates. The engine bolt has sufficient circular play to provide the desired freedom for radial and angular oscillations, which are effected through the shearing deformation of the rubber. The rubber affords much less elasticity in the direction perpendicular to the plates, thus controlling the galloping movements of the suspended mass.

Untersuchungen an Zweitakt-Motoren

By U. Schmidt. Published in *Kraftfahrtechnische Forschungsarbeiten*, No. 7, p. 52. [E-1]

A mathematical analysis is made of certain phases of two-stroke cycle operation, the values used referring to test engine DKW-UBS 350.

The general topic is the relation between scavenging and power and the four specific questions dealt with are:

1. Relation between cylinder pressure after the close of the exhaust port and the degree of charging and scavenging
2. Relation between the degree of scavenging, the mixture of the fuel, the charging and inlet pressure
3. Determination of the theoretical thermal efficiency and the mean theoretical piston pressure
4. Relation between the mean theoretical piston pressure, the degree of scavenging, of charging, of mixture of the fuel and inlet pressure.

The conclusion drawn is that to increase the power of the engine to any considerable degree by providing a vacuum at the exhaust side of the engine is not possible. Methods of increasing engine power within certain limits are also indicated.

Sur un Problème de Carburateur pour le Vol en Altitude avec un Moteur à Compresseur. Adapted by Michel Précoul.

Published in *L'Aéronautique*, March, 1937, *L'Aérotechnique* section, p. 36. [E-1]

A French adaptation of an article appearing in the official publication of the institute of aero-hydrodynamics at Moscow is here presented. It is a theoretical analysis of the variation with altitude of air speed and pressure in airplane engine carbureters, with practical application of the formulas developed to current carbureters and conclusions as to the significance for design of the formulas developed.

In an engine without a supercharger, the air speed in the carbureter is said to decrease inversely with the square root of the absolute temperature; consequently sudden losses in power with altitude are not to be feared.

In an engine with a supercharger, the air pressure at the entry to the supercharger, on the ground, varies from 97 per cent of atmospheric for an air speed of about 230 ft. per sec. to 91 per cent for an air speed of about 390 ft. per sec. With increase in altitude these pressure losses become even more significant. Formulas are developed which show that losses in pressure increase with altitude until they attain a maximum, at which critical altitude the air pressure at the entry to the carbureter is 52.8 per cent of the surrounding atmospheric pressure. Abrupt power losses corresponding to pressure losses are also experienced. The lower the air speed in the supercharger at the ground, the higher is the critical altitude. For practical purposes, the analysis indicates the importance of maintaining the lowest possible air speed in the supercharger at the ground, and presents a method for determining the limitations on the

operation of a supercharged engine having a given supercharger air speed at the ground.

Formulas for determining the carbureter dimensions for a supercharged engine are developed in the second section. Finally for the carbureters of five current supercharged engines, the carbureter air speed at the ground and at the altitude for which the supercharger is adapted is calculated. The customary air speed at the latter altitude was found to be about 45 per cent of the critical speed.

MATERIAL

Eigenartige Erscheinungen bei der Magnetischen Werkstoffprüfung

By Otto Holtschmidt. Published in *Zeitschrift des Vereines Deutscher Ingenieure,* July 17, 1937, p. 862. [G-1]

That extreme care must be taken in the interpretation of the results of the magnetic testing of metals is the thesis of this article. The reason for this is that indications in the pictures obtained which customarily signify flaws in the metal may under certain circumstances be attributable to other causes.

A series of experiments was made to produce such flaw images by cold working under various conditions. The test results show that flaw images are obtained when steel has been subjected to cold working by a rod of ferromagnetic material, if, during the cold working and the testing the surface of the steel has been under elastic strain or if the test piece has been magnetized before the cold working. The strain may be either tension or compression, or of mechanical or thermal origin. Such flaw images may be made to disappear by strong magnetization, demagnetization or heating to a minimum temperature of 250 deg.

Whether flaw images will be obtained when the cold working is done with unmagnetized metal, or when the cold-worked spot of the stressed steel has not been magnetized, is still to be determined.

A practical application of the results of these tests is that they indicate a means by which the presence and extent of natural strain in unmagnetized steel may be determined.

Der Bau der Erdölraffinerie Triest

By Herbert A. Bahr. Published in *Zeitschrift des Vereines Deutscher Ingenieure,* July 17, 1937, p. 849. [G-4]

The refinery, the construction and equipment of which are described, was built to handle 800 tons of crude petroleum daily. The crudes refined are Coastal Crude, Lobitos Low Cold Test Crude, and East Texas Crude. The final products desired were gasoline, with an end point adjustable between 140 and 200 deg., petroleum with an end point of 275 deg. and an initial point at least 10 deg. above the end point of the gasoline, light gas oil with an end point not lower than 340 deg. and an initial point not more than 15 deg. lower than the end point of the petroleum, heavy gas oil, spindle oil, machine oil and bright stock. Further, a white spirit with an end point of 200 deg. was also desired.

A two stage Foster Wheeler distillation plant was selected. Through the provision of additional primary distillation, the plant was made a three stage unit. The first stage, atmospheric distillation, was so designed that in it all the low boiling point products through the light gas oil are obtained. In the second stage, vacuum distillation, the heavy gas oil and the three lubricating oils are extracted. To separate out all constituents of the crude harmful to the distillation unit, hot settling tanks and primary distillation are provided.

In operation, the refinery has more than filled the requirements originally laid down, handling a greater amount of crude daily and providing even stricter control in the distillation range of the products.

PASSENGER CAR

La Technique de la Vente et de la Publicité dans l'Automobile

By Jean Vallée. Published in *Journal de la Société des Ingénieurs de l'Automobile,* April, 1937, p. 260. [L-6]

The author, director of advertising and sales for the Peugeot company, explains the function of advertising; lists a salesman's qualifications and describes methods of test for determining these qualifications; discusses the control of production according to anticipated sales, and methods of estimating possible sales; the general principles of advertising and the variation in the application of these principles according to the medium employed, newspaper, periodical, screen, radio or billboard, and the choice of the theme and the audience for advertising.

MISCELLANEOUS

L'Exposition d'Autorails

By L. Jonasz. Published in *La Vie Automobile,* July 10, 1937, p. 256. [H-1]

At the railcar exposition held by the French railroads in Paris the following makes are shown, and descriptions of them are included in this article: Micheline, Bugatti, Renault, Berliet, Lorraine, Decauville, Dietrich, Franco-Belge, Aciéries du Nord, Standard and Charentaise.

GEAR-SHIFT CHANGES

Spotlighted in 1938 Design Trends

By Austin M. Wolf

NEW types of gear-shift control are prominent among the many mechanical changes which have been made in the 1938 models. Several different devices make their bow and modifications have been made in several already available on 1937 models. The conventional transmission has been challenged.

In addition to the new gear shifts, almost every maker has incorporated special changes of technical interest. The Cadillac 135 deg. V-16, for example, bristles with new features, one of which is the frictionally driven generator. The Cadillac "60" discloses new details of body construction and the LaSalle molding is placed below the belt. Buick offers a "turbulator" piston and coil-spring rear suspension. The diaphragm spring clutch is Chevrolet's outstanding contribution. A new vogue is introduced in the Chrysler products with the front apron cutting off the stereotyped bottom of the radiator grille. Graham's sensational styling of fenders, hood, body and belt rail is notable. The Lincoln Zephyr has a new streamlined front with low louvre openings. Nash is offering a more pretentious ventilating system. Oldsmobile's fenders, high aprons and invisible louvre, present a new styling. Packard has contributed a new rear suspension system in which the shock absorbers and sway eliminator take a prominent part. The Studebaker frame X-member shows originality.

There is a slight indication of a drop from extreme compression ratios, a greater number of batteries are located under the hood, the direct-acting shock absorbers are more prevalent and the rear stabilizer link has found new adherents. Grilles are slightly wider and have fewer bars. The safety front seat and recessed controls are widely used. Heat and sound body insulation has made considerable advances and luggage compartments are further improved.

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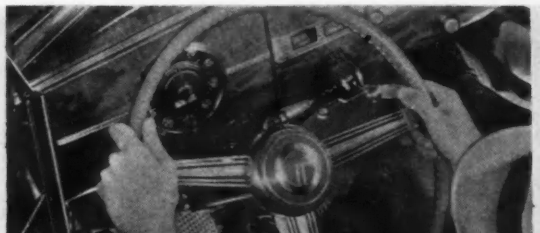
Read the Whole Story!

Buick



Nash
Cadillac

Hudson
Oldsmobile

Studebaker
Pontiac

News of the Society

Candid Opinions Predominate at Aircraft Meeting Sessions

INTENT on keeping America first in aviation, 1000 of the industry's foremost executives, engineers and designers were in almost continual session from Oct. 7 to 9, at the second SAE National Aircraft Production Meeting, Ambassador Hotel, Los Angeles.

It was a meeting marked with frankness. Europe's rapid strides in aviation due to generous government subsidies and fear of war were clearly revealed. The efforts of our government to plan in peace for mobilization of aircraft and other military requirements in case of war – or to safeguard us from war – were described, with forceful reminders of America's waste of men and wealth due to lack of preparedness in 1917. Stainless steel, aluminum, magnesium and plastics, their present uses and future possibilities, as well as their limitations, were more than adequately described by number one men in each field. Maintenance experts from the Army and Navy as well as transport companies mixed praises of aircraft manufacturers' ingenuity with suggestions as to needed design revision to provide better accessibility; to guard against corrosion; for standardization. Modern production equipment was the subject of much discussion and free interchange of information by representatives of leading aircraft manufacturers. Phases of design research were brought to light dealing particularly with recent air-cooled engine cowling work of the National Advisory Committee for Aeronautics.

Every paper on the dynamic program had its part in fulfilling President Harry T. Woolson's opening-session prophecy that the meeting would make another high mark in SAE annals.

Introduced by Carleton E. Stryker, general chairman of the meeting, Mr. Woolson gave a brief talk of welcome offering thanks to Mr. Stryker and his committees, officers and members of the four SAE Pacific Coast Sections, the Aeronautical Chamber of Commerce of America, and the Air Transport Association of America, all of which cooperated in making the meeting a huge success.

He was followed by W. C. Clayton, engineering executive, Aeronautical Chamber of Commerce, who brought greetings from his organization and declared that meetings of this sort can be put on better by the SAE than by any other group. Hugh W. Coburn, Western Air Express, spoke on behalf of the Air Transport Association. He conveyed regrets from Col. Edgar S. Gorrell, president of ATA, at not being able to attend.

The presentation of the Wright Brothers Medal to three Boeing engineers for their paper "Design and Construction of Large Aircraft" read before last year's National Aircraft Production Meeting, was one of the most impressive events of the meeting. At the banquet, Past-President E. P. Warner made the presentation to F. P. Laudan, who received it on behalf of his two co-authors, J. K. Ball, and R. J. Minshall. The medal is awarded annually for the best paper on aerodynamics or structural theory or research, or airplane design or construction, presented at a meeting of the Society or any of its Sections.

Friday morning a goodly number of the convening engineers journeyed to California Institute of Technology, whose laboratories house much of the experimental work carried on by and for California's aircraft companies. W. C. Rockefeller of C.I.T. conducted the trip.

The whole affair wound up with a gala banquet and ball Saturday night, the only social event of the meeting. Past-President W. B. Stout presided. Two of the busiest men at the meeting were Fred C. Patton, treasurer of the Southern California Section, who handled ticket sales for the banquet, and E. E. Tattersfield, chairman of the banquet committee.

A dynamometer for use while in flight – that is a terse definition of the torque indicator designed and developed by Pratt & Whitney Division of United Aircraft, which was described by P&W's chief test pilot A. L. MacClain and R. S. Buck, project engineer, in a joint paper presented by Mr. MacClain at the opening session. He was introduced by J. W. Young, North American Aviation. How this device, in which the reaction forces of the fixed gear in the propeller reduction gearing are measured, can be used with a constant-speed propeller to make complete engine calibrations of power versus manifold pressures at various engine speeds and altitudes, was explained. Among the many interesting results of tests are the extent that humidity affects engine power, and the fall in gross fuel consumption with altitude. To the pilot the torque indicator is an aid in regulating mixture strengths, in checking ignition, adjusting carburetor pre-heat and, primarily, in controlling the engine power, Mr. MacClain stated. The added weight he said is about 20 lb.

Answering questions by Dr. C. B. Millikan and Dr. A. L. Klein of California Institute of Technology, and James B. Edwards of Douglas, Mr. MacClain told that the torque indicator shows that some power is sacrificed with cowling, although in the tests thus far made only one type of cowling was used. He expects that torque indicators will be supplied for test purposes and may eventually be built into all geared engines.

Donald H. Wood, aeronautical engineer, National Advisory Committee for Aeronautics, who was to present his paper on "Design of Cowlings for Air-Cooled Engines" was held up en route from Washington. Fortunately R. G. Robinson, N.A.C.A. engineer in charge of the high-speed tunnel at Langley Field, vacationing in Southern California, was prevailed upon to pinch hit. The N.A.C.A. is taking a new tack in its work on cowling, said Mr. Wood in his paper, that is characterized by the correlation of the cooling function of the cowl with the drag-reducing function into a rational design procedure. Earlier work, he stated, was devoted largely to drag reduction, and this in a cut-and-try way. He pointed out that the shape of the cowling nose is not critical and the part of

(Continued on page 24)

Presentation of Wright Brothers Medal

Past-President E. P. Warner presents the Wright Brothers Medal to F. P. Laudan who received it on behalf of himself and two co-recipients, J. K. Ball and R. J. Minshall. These three Boeing engineers were awarded the Medal for their paper "Design and Construction of Large Aircraft," judged the best paper on aerodynamics or structural theory or research, or airplane design or construction, presented before the Society or any of its Sections last year.

Diesel Proponents Win Debate at Tulsa F. & L. Meeting

"THE Diesel type of engine is more desirable than the gasoline engine for automotive equipment." At least that was the unanimous decision of the judges on the basis of the arguments given during the spirited debate on this proposition that closed the SAE National Regional Fuels and Lubricants Meeting, Tulsa, Okla., Sept. 30 to Oct. 1, 1937. Students of Tulsa University, taking the affirmative side, delivered more telling arguments than the team from the University of Oklahoma championing the gasoline engine in a comparison of advantages and disadvantages of the two types from technical, mechanical, and practical viewpoints, in the judges' opinion. B. E. Sibley, Continental Oil Co., who was general chairman of the committee on arrangements for the entire meeting, was chairman at the Dinner Session at which the debate was the feature.

This verbal clash proved a novel and stimulating climax to an unusually diversified program which packed into two days, in addition to the debate, nine papers and a talk prepared by John A. C. Warner, secretary and general manager of the SAE, and presented in his absence by SAE Research Manager C. B. Veal. The papers spread over the entire range of applications, production, and utilization of fuels and lubricants in the automotive field. The Diesel engine was the subject of two papers – one on its development in the oil country, and another on its fuel utilization. The economic place of the oil engine; privately owned airplanes; bus fleet maintenance; improvements in seasonal gasoline and lubricating oil; engine cooling; hypoid lubricants; and automotive equipment in geophysics research, were the themes of the other six papers. The vigor and quality of the discussions following many of these papers showed that not all the debating talent was being saved for the last event of the meeting.

"In its contribution to the building up of this area of the country, the petroleum industry has been eagerly seconded by the automotive industry," reminded Mr. Veal, reading Mr. Warner's speech on SAE Activities, at the dinner on the first day. "On the other hand the automotive industry could never have attained the greatness that it has reached today if it had not been for the vast amount of fuel made available at such low prices," he continued. In the same vein, he gave as an example of the cooperation and dovetailing of interest of the two industries the Cooperative Fuel Research which was called into being to "adapt fuels to engines and engines to fuels." After expressing gratification at the increased attendance at the meeting as compared with the first one held last year, Mr. Veal concentrated his remarks on the activities of the Society in the fuels and lubricants field, charting the organization and schedule of meetings, committees, cooperation with other organizations, and foreign participation.

Cummins Talks on Diesels

The meeting opened with a talk by C. L. Cummins, Cummins Engine Co., about the development of Diesel engines in connection with oil-country problems. Mr. Cummins did not present a formal written paper.

Virtually no trouble has been encountered in lubricating hypoids where approved hypoid lubricants have been used, R. K. Floyd of Frank Harris Floyd, Inc., announced in his paper "Observations on One Year's Lubrication Experience with Hypoids in the Low-Price Brackets." Most of the predicted troubles did not happen, Mr. Floyd thinks, because the program of manufacture and original factory lubrication of the new hypoid equipment last year was carried out with ultra care and accuracy. "It is fair to say," he pointed out, "that the motor companies fully realized the dangers of such a radical change in equipment and lubrication practice, and acted with corresponding care. . . . The oil industry, too, did an honorable-mention job in the celerity with which it attained world distribution of suitable lubricants for the hypoid axles."

In the Fall of 1936, Mr. Floyd said, there were no hypoid lubricants universally available to the public. By the early summer of 1937, there were about 200 approved brands on the market in the United States. The public is not gear-lubricant conscious, Mr. Floyd averred, and added that lubrication control is much more difficult among people who buy low-priced than among those who buy high-priced cars. He concluded with a strong plea for "the closest kind of cooperation in development work" between the petroleum and automotive industries.

The stupendous task which faces the oil engine if it is to replace the modern gasoline engine was forcefully visualized by Arch F. Campbell, Waukesha Motor Co., when, in his talk on "The Economic Place of Automotive Oil Engines," he said:

"After forty years of concentrated effort in its development, the modern gasoline engine, especially in passenger vehicles, has set up standards of quietness, smoothness, reliability, easy starting, high performance, high output per pound, reasonably acceptable economy and universal service – even alley garages can keep it in fair running order.

"Only when we face such facts," he continued, "and realize that they in reality establish the mark at which any designer must shoot if he expects to replace the modern gasoline engine with an oil engine, can we even estimate the possible future of this new substitute prime mover."

To adapt Diesel engines to modern automotive duty, Mr. Campbell said, fundamental design changes are needed, including lighter weight and smaller size; wide speed range; great acceleration; simplified starting; and interchangeability with existing gasoline engine standards. Discussing various small items of Diesel maintenance needs, Mr. Campbell commented that "the importance of these little details can be driven home to the average user only by his getting into serious difficulty through neglect of these simple matters." Talking of corrective maintenance work in connection with the Diesel, Mr. Campbell emphasized as important the point that the original bore of the Diesel engine should never be increased by any appreciable amount, and, if one cylinder is reground, all the rest must be enlarged by the same amount. The combustion and fuel system of the Diesel engine," he said, "is based upon the original displacement and a given combustion-chamber clearance volume so that an appreciably larger bore will upset the fuel-air ratio and the entire combustion system.

"If operators wish to show specific profits on

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T. & M. Questions Answered As 350 Meet in Chicago

SHOULD the nominal ton method of rating trucks be abandoned? Can E-P lubricants be accurately evaluated by machine test methods? Is air conditioning of cars coming, and when? What is the ideal 21- to 25-passenger bus?

These questions and others highlighted the program of the regular meeting of the Chicago Section, held jointly with a regional meeting of the Transportation & Maintenance and Truck, Bus & Railcar Activities of the Society at the Blackstone Hotel, Chicago, on Sept. 29, 30 & Oct. 1, attracting an attendance of 350 guests and members.

At the opening session Wednesday morning, in a paper entitled "Rating a 14,000-lb. Gross Vehicle Weight Motor Truck," Fred L. Faulkner, automotive engineer, Armour & Co., set forth the operator's need for a more satisfactory method of rating a motor truck than the present ton-rating system. Following his introduction by Leo Huff, chairman of the technical session, Mr. Faulkner said that, because of lack of consistency in applying ton ratings by manufacturers, the operator is hard put to evaluate truck models for specific types of service. The wide variation in unit and parts sizes available in truck chassis of the same ton rating, he pointed out, has complicated the problem.

As a basis of rating which would better serve the operator, he advocated a simple system of rating a chassis from two important aspects: (1) its ability to support a load; and (2) its ability to move and stop that load. As factors for rating load-carrying ability he cited rear-axle housing diameter, steering knuckle and frame modulus. As factors for rating ability to move and stop, he listed engine displacement, axle ratios and tire sizes, which give a basis for computing grade ability or performance factor for any gross vehicle weight over any given resistance road. Stopping ability, he continued, can be determined by the ratio of effective service-brake area to the gross vehicle weight. The clutch size, he added, is another important factor.

These rating factors as applied to five manufacturers' models were tabulated by Mr. Faulkner as indicative of a comparative rating method which might be developed by the industry and which would embrace essential engineering factors and eliminate undue emphasis on sales factors. Such a rating method, he pointed out, could not take into consideration types of construction, specialized design, use of high alloy and heat-treatment, which he feels should be left in the merchandising category. By screen slides and tables, Mr. Faulkner illustrated how size in units and parts for 1937 models, as compared to 1934 models, showed a marked variation for the same rated models, revealing a lack of consistency which emphasized further the need of operators for a better rating system than the present nominal ton-rating plan. As a start, for such a system, he advocates the establishment of a rating scale covering seven or more vital chassis parts, including relation to gross vehicle weight.

Pierre Schon, General Motors Truck Co., in a prepared paper discussing Mr. Faulkner's proposal, declared that retention of payload ratings is found advisable due to use of the ton-rating scale by: (1) state vehicle license departments; (2) insurance companies; (3) labor unions. While 18 states employ a gross-

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SAE Aims Discussed By President Woolson

• Oregon

"Engineering spells civilization," SAE President Harry T. Woolson told over 200 members and guests of the Oregon Section Oct. 14 at which he and the Society's general manager, John A. C. Warner were guests of honor. He traced the progress of civilization from the time when some pre-historic engineer whittled out crude discs to form the first wheels. Continuing to the present, Mr. Woolson explained the SAE's part in advancing automotive engineering. We are pushing on to new achievements guided by our symbol, the five-pointed star, he declared. Each of the star's points is an SAE objective, he added, naming them more powerful membership, accelerated standardization, intensified research, vital technical papers and broader engineering relations.

Mr. Warner devoted his talk to headlighting with special emphasis on recent advancements in the science despite limiting and conflicting legislation in the various states.

Section Chairman Joseph P. Seghers presided and introduced guests seated at the speakers' table including: George W. Peavy, president, Oregon State College; Ex-Senator Douglas McKay; Dr. E. B. Daniels, president, Oregon AAA; Catlin Wolfard, Automobile Dealers Association; Dave White, President Portland Automotive Trades Association; Ray Carr, Carr Advertising Service and Carl Gabrielson, representing the Secretary of State. George L. Baker, ex-mayor of Portland, welcomed Mr. Woolson and Mr. Warner to the city.

The day before the meeting Mr. and Mrs. Woolson, Mr. Warner and a number of Oregon Section Members motored to Bonneville for the afternoon.

The Oregon Section opened its season of activity Sept. 10 with an organization and planning meeting. It was well attended by old members and several new members were introduced.

Section Chairman Joseph P. Seghers outlined the year's work and charged the various committeemen with their duties in detail. He then reviewed the automotive industry, past and present, locally and nationally. William F. Carper discussed the new fuel requirements.

Oregon Section Friday luncheons are continuing as popular as ever with attendance ranging from 25 to 50. Short programs are arranged for each of these weekly meetings.

Safety Talk by Hunt Stimulates Discussion

• Indiana

The Indiana Section got off to a good start in its first meeting of the season, Oct. 14, when John H. Hunt, director, New Devices Section, General Motors Corp., gave his paper "Automobile Design and Safety," which was followed by brief discussion-talks by Prof. H. M. Jacklin, Purdue University; C. A. Michel, Guide Lamp Corp.; and William K. Creson, chief engineer, Ross Gear and Tool Co.

It was an old-fashioned gathering for the Section with more old timers and Section men from other cities in the state than have been at hand at one time in some years. Seventy-two arrived for the dinner and there were 160 in the hall when the regular meeting was called to order by Section Chairman R. M. Critchfield. Among the other out-of-city delegations present were thirty members of the SAE Student Branch at Purdue University who came early in the day and made an inspection trip through the Marmon-Herrington plant before the meeting.

Mr. Hunt's paper riveted attention from the start and stimulated much discussion. Several

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SAE *Coming* EVENTS

Baltimore—Nov. 4

Engineers Club; dinner 6:30 P.M. Design Trends for 1938 – Austin M. Wolf, automotive consultant.

Canadian—Nov. 22

Mount Royal Hotel, Montreal; dinner 7:00 P.M.

Chicago—Nov. 8

Stock Yards Inn; dinner 6:45 P.M. Automobile Show Meeting. Where Current Design Trends Are Pointing – Norman G. Shidle, executive editor, SAE JOURNAL.

Cleveland—Nov. 8

Cleveland Club; dinner 6:30 P.M. General Automobile Service Problems – W. A. Houser, general parts and service manager, Cadillac Motor Car Co.

Detroit—Nov. 8

Statler Hotel; dinner 6:30 P.M. Design Trends of 1938 – Austin M. Wolf, automotive consultant.

Indiana—Nov. 11

Hotel Severin, Indianapolis; dinner 6:30 P.M. Review of the New Cars and the Shows – Lee Oldfield, vice-president in charge of engineering, Bennett Mfg. Co.

Metropolitan—Nov. 9-10

Robert Treat Hotel, Newark, N. J. Regional Transportation and Maintenance Meeting. For detailed program see p. 22, this issue.

Milwaukee—Nov. 5

Athletic Club; dinner 6:15 P.M. Vision Lined Engine for the Vision Lined "Z" Tractor – A. W. Lavers, chief engineer, Tractor and Engine Division, Minneapolis Moline Power Implement Co.

New England—Nov. 9

Walker Memorial, M. I. T., Cambridge, Mass.; dinner 6:30 P.M. Review of 1938 Models – Dean A. Fales, associate professor, automotive engineering, Massachusetts Institute of Technology.

Annual Dinner
Oct. 28 — New York
Commodore Hotel

Metropolitan Section Regional T & M Meeting
Nov. 9-10 — Newark, N. J.

West Coast Section Regional Transportation Meeting
Nov. 18-19, San Francisco, Calif.
Fairmont Hotel

National Production Meeting
Dec. 8-10 — Flint, Mich.
Hotel Durant

Annual Meeting
Jan. 10-14, 1938 — Detroit
Book-Cadillac Hotel

National Passenger Car Meeting
March 28-30, 1938 — Detroit
Hotel Statler

Summer Meeting
June 12-17, 1938
White Sulphur Springs, W. Va.
The Greenbrier

Northern California—Nov. 18-19

Fairmont Hotel, San Francisco. West Coast Regional Transportation and Maintenance Meeting. The Northwest, Oregon and Southern California Sections will participate in this meeting. For detailed program see p. 23, this issue.

Northwest Nov. 12

Mayflower Hotel, Seattle, Wash.; dinner 6:30 P.M. Fundamentals of Axle Engineering – A. K. Brumbaugh, West Coast representative, Timken-Detroit Axle Co.

Oregon—Nov. 13

Multnomah Hotel, Portland; dinner 6:30 P.M. Annual Social Night.

Philadelphia—Nov. 17

Engineers Club; dinner 6:30 P.M. Critical Analysis of 1938 Cars, and Probable Engineering Trends – Joseph Geschelin, Detroit technical editor, Chilton Co.

Pittsburgh—Nov. 16

Webster Hall; dinner 6:30 P.M. Cab-Over-Engine Trucks – B. B. Bachman, vice-president, chief engineer, Autocar Co.

Southern California—Nov. 12

Los Angeles; dinner meeting. Reducing Driving Hazards – Paul G. Hoffman, president, Studebaker Corp. Elevated Roads or Arteries – E. E. East, chief of engineering, Automobile Club of Southern California. Highway Design for Reducing Accidents – F. J. Grumm, engineer of surveys and plans, State of California.

Syracuse—Nov. 15

Onondaga Hotel; dinner 6:30 P.M. Critical Analysis of 1938 Cars and Probable Engineering Trends – Joseph Geschelin, Detroit technical editor, Chilton Co.

Washington—Nov. 9

Cosmos Club; dinner 6:30 P.M. Subject – 1938 Passenger Cars.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Sept. 15, 1937, and Oct. 15, 1937.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

AMBRUSTER, WATSON, II (J) road test and dynamometer work, Pontiac Motor, Division of General Motors Corp., Pontiac, Mich. (mail) 675 East Mansfield Ave.

ANTHONY, FELIX M. (A) vice-president and supervising engineer, Super Power Spark Plug Co., 4514 Hollis St., Oakland, Calif. (mail) 1124 Warfield Ave., Piedmont, Calif.

ARCHIBALD, FRANK ROGERS (M) technical service supervisor, National Carbon Co., Inc., Room 1204, 30 East 42nd St., New York City.

ATCHESON, WINDSOR K. (M) superintendent, S. W. Producing Div., Motor Transportation Dept., Pure Oil Co., Sixth & Cheyenne, Tulsa, Okla. (mail) Post Office Box 271.

BARRON, EDWARD T. (M) manager, Metallurgical Dept., Pittsburgh District, Carnegie-Illinois Steel Corp., 765 Frick Bldg. Annex, Pittsburgh, Pa.

CARR, ERNEST H. (A) vice-president, manager, Canadian Plant, Motor Products Corp., 1508 Walker Road, Walkerville, Ontario, Canada.

CIPRIANI, CHESTER (J) junior engineer, Electric Auto-Lite Co., Toledo, Ohio. (mail) 1110 Jefferson Ave.

CLARKE, HERBERT E. (A) regional representative, Miller Tool & Mfg. Co., 1725 16th St., Detroit, Mich. (mail) 85 St. Andrews Place, Yonkers, N. Y.

DENGLER, GEORGE A. J. (M) chief engineer, general manager, Home Trailer & Mfg. Co., Inc., 308 Exporting St., Aurora, Ind. (mail) Post Office Box 11.

DENNING, WILLIAM J. (M) general manager, Do Ray Lamp Co., 1458 South Michigan Ave., Chicago, Ill.

DONALDSON, CHASE (A) vice-president, Briggs Clarifier Co., 3262 K St., North West, Washington, D. C.

DRAPEAU, H. B. (M) bi-metal and thermostat engineer, Dole Valve Co., 1923 Carroll Ave., Chicago, Ill. (mail) 807 South Cuyler Ave., Oak Park, Ill.

FAIR, DAVID RAMEY (A) branch manager, vonHamm-Young Co., Honolulu, T. H. (mail) Post Office Box 76, Wahiawa, T. H.

FAWCETT, L. L. (A) owner, Auto Electric Co., Ponca City, Okla. (mail) 118 West Grand.

GRIFFIN, EDMUND FRANCIS (A) sales, Laidlaw Co., Inc., 16 West 60th St., New York City.

HEDSTROM, GUSTAV (M) layout draftsman, Nash-Kelvinator Corp., Nash Motors Div., Kenosha, Wis.

HEINLEIN, FRED (M) superintendent, transportation, Cincinnati Gas & Electric Co., Fourth & Main Sts., Cincinnati, Ohio.

JAMES, JOHN A. (J) instructor, Delehanty Institute, 11 East 16th Street, New York City. (mail) 1332 Jefferson Ave., Brooklyn, N. Y.

JENKS, GLEN F., COL. (S M) chief of technical staff, U. S. Army, Ordnance Dept., Office, Chief of Ordnance, Washington, D. C.

LEWIS, LEWIS DAVID (F M) production manager, E. G. Eager & Son, Ltd., Brisbane, Queensland, Australia. (mail) Blackstone, Ipswich, Queensland, Australia.

LI, TING-KUEI (F M) dean, Industrial Dept., Oberlin Shansi Memorial Schools, Taiku, Shansi, China.

MANSFIELD, JOHN D. (A) president, Chrysler Corp. of Canada, Ltd., Windsor, Ontario, Canada.

MANTHEY, LARRY (A) sales engineer, Allen Electric & Equipment Co., Kalamazoo, Mich. (mail) 1211 Elmdale Ave., Chicago, Ill.

MARANOV, SIDNEY (A) manager, Balmacaan Racing Team, Inc., Westbury, L. I., N. Y. (mail) 39 Utterby Road, Malverne, L. I., N. Y.

MARTIN-HURST, WILLIAM F. F. (A) managing director, British Thermostat Co., Ltd., Windmill Road, Sunbury-on-Thames, Middlesex, England. (mail) "Bramleigh," Ashley Road, Walton-on-Thames.

MOTT, BENJAMIN CORNELL (A) director, Field Obs. Section, General Motors Corp., Room 14-221 General Motors Bldg., Detroit, Mich.

OBER, WILLY OTTO (A) combustion engineer, Gulf Oil Corp., 17 Battery Place, New York City. (mail) 3448 Corsa Ave.

PEDLEY, H. A. (A) district operating manager, Socony-Vacuum Oil Co., Inc., Church St., Albany, N. Y.

PFOST, LESTER S. (M) tractor engineer, Massey-Harris Co., Racine, Wis.

RAWLINGS, EVERETT C. (A) mechanical salesman, Standard Oil Co. of Calif., 225 Bush St., San Francisco, Calif. (mail) South 1518 Tacoma, Spokane, Wash.

SAMPIETRO, ACHILLES CHAS. (F M) assistant chief engineer, experimental work, Clement Talbot & Sunbeam, Ltd., 10 Barlby Road, London, W. 10, England.

SCHEDELER, HERMAN HENRY (M) tool designer, Clark Equipment Co., Berrien Springs, Mich. (mail) 209 South Main St.

SHAW, C. W. (A) assistant to director, engineering research, Eaton Mfg. Co., 9771 French Road, Detroit, Mich.

SHAW, W. WILBUR (A) consulting racing engineer, Merz Engineering Co., 937 North Capitol Ave., Indianapolis, Ind. (mail) 4519 Guilford Ave.

SMIROF, M. O. (F M) head designer, Moscow Automobile Plant "ZIS," Moscow, U.S.S.R. (mail) Zis Commission, Amtorg Trading Corp., 261 Fifth Ave., New York City.

SMITH, H. S. (A) sales manager, Burgess-Norton Mfg. Co., Geneva, Ill.

SPAULDING, DAVID CHASE, JR. (M) research engineer, Standard Oil Co. (Ohio), Midland Bldg., Cleveland, Ohio. (mail) 1285 West 89th St.

SPICACCI, ATTILIO R. (M) assistant chief engineer, New Departure Division of General Motors Corp., 2222 South Figueroa St., Los Angeles, Calif.

SUGIURA, SHIGEZO (F M) chief engineer, Sumitomo Metal Industries, Ltd., 56 Shimayacho, Konohanaku, Osaka, Japan. (mail) c/o Sumitomo Bank, Ltd., 149 Broadway, New York City.

TANGNER, CARL A. (A) service manager, Downtown Chevrolet Co., 401 South Elgin, Tulsa, Okla. (mail) 2416 North Boston.

TASKER, DONALD K. (A) sales, White Motor Co., Boston, Mass. (mail) 140 Woodlawn Ave., Wellesley Hills, Mass.

THOME, JOHN MACON (J) draftsman, Caterpillar Tractor Co., Peoria, Ill. (mail) 504 Eckley St.

VANDERPLOEG, JACOB SMITH (A) sales manager, Anaconda American Brass, Ltd., New Toronto, Toronto 14, Ontario, Canada.

WAY, GILBERT (M) automotive engineer, Ethyl Gasoline Corp., 863 E Street, San Bernardino, Calif.

WEBER, E. F. (M) superintendent, automotive power, Chicago, Burlington & Quincy Railroad Co., 547 West Jackson Blvd., Chicago, Ill. (mail) Room 1300, Burlington Bldg.

WHITTAKER, HARRY MILES (M) chief engineer, Micromatic Hone Co., 7401 Dubois St., Detroit, Mich.

WRIGHT, JOSEPH PRESTON (A) plant superintendent, Cities Service Oil Co., 525 East Michigan Ave., Milwaukee, Wis. (mail) 1714 East Kensington Blvd.

ZIPPERLEN, CHARLES P. (M) transportation manager, Breyer Ice Cream Co., 43rd below Woodland Ave., Philadelphia, Pa.

Applications Received

The applications for membership received between Sept. 15, 1937, and Oct. 15, 1937, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

ALEXANDER, COL. E., Alexander Automotive Engine Co., Inglewood, Calif.

ALLEN, ELEANOR, detailer airplane wheel and brake division, Bendix Products Corp., South Bend, Ind.

ANDERSON, MARSHALL SYLVESTER, tractor and power plant salesman, McCarty-Sherman Motor Co., Denver, Colo.

ARLEN, FRANK, Universal Equipment Co., Detroit, Mich.

ARMINGTON, RAYMOND Q., vice-president and factory manager, The Euclid Road Machinery Co., Euclid, O.

BALL, THOMAS M., experimental engineer, Chrysler Corp., Detroit, Mich.

BENDER, RENE JOSE, fuel oil engineer, Sinclair Refining Co., Chicago, Ill.

BERGMANN, THOMAS FAY, test engineer, Wright Aeronautical Corp., Paterson, N. J.

BERGSTROM, ALBERT L., chief works engineer, Timken Roller Bearing Co., Canton, O.

BOLLSTROM, CHARLES E., tool designer, Clark Equipment Co., Berrien Springs, Mich.

BUFFA, FERDINAND J., 1125 63rd St., Brooklyn, N. Y.

BURGESS, ARCHIE R., instructor, Washington University, St. Louis, Mo.

CARLSON, RAYMOND M., chief engineer, Taylor-Young Airplane Co., Alliance, O.

CENZER, CARL W., body engineering, Hudson Motor Car Co., Detroit, Mich.

CHAMBERLAIN, HAROLD, manufacturers' sales department, Goodyear Tire & Rubber Co., New Toronto, Ont., Canada.

COMBERIATE, MICHAEL B., inspection, Sperry Gyroscope Co., Brooklyn, N. Y.

CONWELL, JOHN W., charge experimental laboratory, Tide Water Associated Oil Co., Drumright, Okla.

CRAWFORD, KARL B., assistant to president, American Coach & Body Co., Cleveland, Ohio.

CRONE, ROY C., mechanical engineer, The Texas Co., Beacon, N. Y.

DESMOND, MINOT S., salesman, Socony-Vacuum Oil Co., Lowell, Mass.

EATON, JOSEPH O., JR., engineering research, Eaton Mfg. Co., Detroit, Mich.

ELLIS, CHESTER A., test engineer, Wright Aeronautical Corp., Paterson, N. J.

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About SAE Members:

George A. Stauffer, who has been sales manager, aluminum division, Thompson Products, Inc., Cleveland, was recently promoted to the position of vice-president and general manager, Thompson Products, Ltd., St. Catharines, Ontario.

Ralph O. Ensign is planning engineer for The Le Roi Mfg. Co., Milwaukee.

Walter R. Herfurth, former supervisor of automotive equipment, Seaboard Freight Lines, Inc., New York, has joined R. H. Macy & Co., Inc., as superintendent of garages.

A. G. Lindenthal is now owner of the Concord Buick Co., Concord, N. H. He was formerly general service manager, Strang Buick Co., Inc., Jamaica, L. I., N. Y.

W. J. Cullen, formerly automotive engineer, Sinclair Refining Co., Chicago, is now connected with the Chek-Chart Corp., as associate editor.

Claude E. Kissinger, who was assistant mechanical engineer, design, National Advisory Committee for Aeronautics at Langley Field, Va., is now associated with the Interstate Commerce Commission, Bureau of Locomotive Inspection, Washington, D. C., in the same capacity.

Ralph M. Heintz has joined the Bendix Aviation Corp., East Orange, N. J. He was formerly president and general manager of Heintz & Kaufman, Ltd., South San Francisco, Calif.

Louis Stevens, formerly superintendent of garages, U. S. Army, Motor Transport, Fort Brady, Sault Ste. Marie, has joined the Bureau of Biological Survey of the United States Department of Agriculture, Portland, Ore., as inspector of Equipment, CCC.

John R. Bond has been transferred from dynamometer operator to draftsman, Olds Motor Works, Lansing, Mich.

William L. Hull is instructor in mechanical engineering, Purdue University, West Lafayette, Ind. He was formerly mechanical engineer, Chrysler Corp., Highland Park, Mich.

Harold D. Hoekstra has joined the Bureau of Air Commerce, Washington, D. C., as aeronautical engineer. He was formerly designer, Stinson Aircraft Corp., Wayne, Ind.

Bendix-Westinghouse Changes

Six SAE members have been affected by recent changes made by the Bendix-Westinghouse Automotive Air Brake Co. C. A. Ohl, who has been director of sales and acting director of engineering, has been made director of sales and engineering with headquarters at the company's general offices in Pittsburgh. Fred L. Hall, formerly eastern district manager, has been appointed sales manager and transferred from New York to Pittsburgh. R. H. Casler has been appointed chief field engineer with headquarters in Pittsburgh. He was previously central district engineer with offices in Detroit.

A. R. Leukhardt is district engineer with headquarters at New York; A. V. Howe has been advanced from assistant district manager to district manager, located in Detroit; and J. P. Weber is in charge of factory accounts in Cleveland.

W. R. Oelschlager, who was general foreman, Diesel fuel injection department, International Harvester Co., Milwaukee, is now general foreman, Diesel engine and fuel pump manufacture.

Howard Cooper has been advanced to chief lubrication engineer by Sinclair Refining Co., New York. Before this change he was assistant manager, domestic lubricants sales.

F. T. Irgens
Becomes V.P.

F. T. Irgens, who was chief engineer, Outboard Motors Corp., Milwaukee, has been advanced to vice-president and works manager.

Fred M. Zeder, Chrysler Board Vice-Chairman, who sailed for Europe Sept. 22, expects to return to the United States early this month.

W. E. England has resigned his position as chief engineer, Willys-Overland Motors, Inc.

Eugene L. Wagner, Denver, Colo., is now distributor for Buda Diesel and gasoline engines. His new address is 621 West Colfax Ave.

C. B. Whittaker can now be addressed at Messrs. Pietersburg Garage (Pty.) Ltd., P. O. Box 33, Pietersburg, Transvaal, South Africa.

Walter William Stevens, Jr., former University of California student, has joined the Electro Metallurgical Sales Corp., San Francisco, as sales engineer.

John A. Zbikowski is junior clerk in the City of Detroit Water Department. He recently completed his studies at Lawrence Institute of Technology.

Robert R. Burkhalter, formerly designer with Spicer Manufacturing Corp., Toledo, has been made assistant chief draftsman.

Howe H. Hopkins has joined the Chrysler Corp. as district service representative. He will make his headquarters in Kingston, Pa.

Joseph H. McDuffee, president of the Prest-O-Lite Storage Battery Corp., has been elected vice-president of the Electric Auto-Lite Co., of Toledo. He is retaining his Prest-O-Lite office and will make his headquarters in Toledo.

V. E. Crawford has resigned his position as vice-president of Thompson Products, Ltd., Canada, to enter business in the United States.

George Mueller, Jr., has joined the Hooven-Owens-Rentschler Co. (Diesel Division of General Machinery Co.), Hamilton, Ohio, as draftsman. He was formerly sales engineer with LeBlond-Schacht Truck Co., Cincinnati.

R. T. Haslam, sales manager, Standard Oil Co. of N. J., was host at a luncheon at the Hotel Pennsylvania, New York City, on Sept. 28, given in honor of Miguel Divo, Argentine sportsman, who had just completed a 22,000-mile motor trip from Buenos Aires, Argentine, to New York City taking over 2½ years. Through his interpreter, Mr. Divo told of the adventures and hardships of his trail-blazing trip in a Model T Ford through jungles, deserts, and over mountains, that took the lives of two of his companions.

Donald E. Whitehead is with the Shell Petroleum Corp., in Cleveland. He was formerly traveling representative, Lubri-Zol Corp.

Jessel S. Whyte has been made president and general manager of the Mac Whyte Co., Kenosha, Wis. He was formerly vice-president and general manager.

W. W. Sloane, who was chief designing engineer, Goodman Mfg. Co., Chicago, has been promoted to chief engineer.

G. C. MacDonald, formerly junior agricultural engineer, U. S. Soil Conservation Service, is affiliated with the Central Diesel Co., Detroit, as junior test engineer.

Harold V. Nutt has been advanced to vice-president and manager of the U. S. Diesel Corp., Allston, Mass. Prior to his promotion Mr. Nutt was an instructor in the above company.

Alfred R. Lange has joined the Sulflo Corp. of America, Elizabeth, N. J., as general manager.

B. J. Higi is engineer, equipment department, Delco-Remy Div., General Motors Corp., Anderson, Ind. He was formerly inspector, Delco-Remy Corp.

Francis Rodwell Banks, who has recently been named assistant secretary of Ethyl Export Corp., London, as announced in the September SAE JOURNAL, will continue to handle all of the technical matters which have been under his supervision in the past, in addition to carrying on his new activities.

H. V. Thaden
Joins Carnegie-Illinois

H. V. Thaden has joined the Carnegie-Illinois Steel Corp., Stainless Steel Division, Pittsburgh, Pa. He was formerly with the Fairchild Aviation Corp., Hagerstown, Ind.

American Bantam Appointments

H. I. Hazzard and A. C. Olander have been appointed, respectively, chief engineer and sales manager of the American Bantam Car Co., Butler, Pa. Mr. Hazzard was formerly with International Harvester Co. and the passenger car division of Lycoming Manufacturing Co., Williamsport, Pa. Mr. Olander comes to American Bantam from the Studebaker Sales Corp. He has also been associated with Bendix Aviation Corp.

4 Committee Changes Get Council Approval

Four changes of personnel in SAE committees were approved by the Council at its Sept. 21 meeting, two in the standards and two in the research division.

Ernest Wooler moves from vice-chairman to chairman of the Ball and Roller Bearings standards division following the death of previous chairman George R. Bott, while Eugene Ayres replaces H. T. Kennedy as a member of the Lubricants Division.

Lieut.-Comm. J. V. Carney takes the place of Lieut. C. E. Ekstrom on the Fuels Research Committee. Herman Hanni and E. S. Twining are now members of the Ignition Research Committee, the latter taking the place of the late O. C. Rohde.

A. N. Lappin, formerly engineer, Sikorsky Aircraft Corp., Stratford, Conn., is now connected with Michael Gregor, New York City, as stress analyst.

A. E. Vallier, field representative, Ethyl Gasoline Corp., Des Moines, has been transferred to Detroit, as sales engineer.

J. F. McNerney is experimental helper, Texas Co., Glenham, N. Y. He was previously service manager, Boro-Motors-Pontiac Dealer, Brooklyn, N. Y.

Alfred P. Sloan, Jr., chairman of the board, General Motors Corp., who previously had offices at 1775 Broadway, will now make his New York headquarters at 75 Rockefeller Plaza.

T. L. Holland, previously president of the Anglo-American Chemical Corp., Philadelphia, has joined the Lubrisol Sales Co., Cleveland, as vice-president.

Ernest Molnar, who has been a student engineer with the Buckeye Steel Castings Co., Columbus, Ohio, has been made castings checker by that company.

Tage Hansen, former service manager of Arlington Oldsmobile, Arlington, Mass., is now with the Waltham Automotive Corp., Waltham, Mass., as motor mechanic and rebuilder.

Thomas Midgley, Jr., vice-president of the Ethyl Gasoline Corp., New York, was one of the principal speakers at the recent celebration noting the centennial of the birth of Charles Frederick Chandler, pioneer industrial chemist and founder of the Columbia School of Mines.

Speak on Lubricating Grease Institute Program

Four SAE Members participated in the program of the National Lubricating Grease Institute at its Fifth Annual Convention, held in Chicago last month. H. C. Mougey, chief chemist, Research Laboratory Division, General Motors Corp., Detroit, presented a paper on Hypoid Gear Lubrication; W. S. James, chief engineer, Studebaker Corp., South Bend, on Chassis Lubricants and Lubrication; H. R. Reynolds, chief engineer, Fafnir Bearing Co., New Britain, Conn., on Lubrication Problems Presented by Different Types of Ball Bearing Applications; and Ralph R. Matthews, Battenfeld Grease & Oil Corp., Kansas City, on Laboratory Equipment and Methods for Testing Lubricating Grease.

SAE members serving on the program committee were: F. C. Kerns, R. R. Matthews and Sydney Bevin.

. . . . At Home and Abroad

L. C. Josephs, Jr., chief engineer, Mack Manufacturing Co., Allentown, Pa., recently was elected vice-president and member of the board.

P. E. Parker, formerly chief engineer, Witte Engine Works, Kansas City, Mo., is now connected with the Weber Engine Co., Kansas City, as assistant chief engineer.

J. O. Johnston has culminated his connection as works manager and director, Thornycroft (Aust.) Ltd., Sydney, Australia, and is now located in England.

Charles W. Phelps has left the faculty of the Connecticut State College, Storrs, Conn., where he was instructor in engineering.

E. N. Earman, assistant zone service and mechanical manager, Chevrolet Motor Division, has been transferred from Des Moines, Iowa, to North Tarrytown, N. Y.

Richard H. Johnson, formerly assistant to chief engineer, Perfex Radiator Co., Milwaukee, has joined the Ingersoll Rand Co., Painted Post, N. Y., as engineer.

Clarence E. Moore, who was service engineer, Kelley Buick Sales & Service, Columbus, Ohio, has joined the U. S. Department of Agriculture, Bureau of Biological Survey, Omaha, Neb., as supervising mechanic.

William J. Foster, formerly district manager, sales promotion, Chevrolet Motor Co., New York, is now New York zone truck manager, Chevrolet Motor Division.

Fred Haller, Mt. Lebanon Garage Co., Lebanon, Pa., is the new treasurer of the Pittsburgh Section of the Society. He replaces Charles R. Lund, who resigned.

Joseph John Dziewonski has been named technical vice-director of "PZL" (National Aircraft Works, Engine Division) at Warszawa, Okecie, Poland. He was formerly manager of the aeroplane engine department.

Dr. F. C. Reggio has joined the Sterling Engine Co., Buffalo, N. Y., in the capacity of consulting engineer.

Hans Johan Uno Forsberg, now assistant managing director, has been named managing director of Aktiebolaget Svenska Kullagerfabriken, Gothenburg, Sweden, to take office Jan. 1.

Alfred Schwarz, formerly treasurer of the Automotive Economy Corp., Jersey City, is now treasurer and chief engineer.

Clayton B. Seymour has joined the Hoof Products Co., Chicago, doing governor and accessory development work. He was previously in the engineering department, Bendix Products Corp., Stromberg Division, South Bend.

Prof. Jerome C. Hunsaker, head of the mechanical engineering department, Massachusetts Institute of Technology, on Oct. 12 presented a paper on the development of transoceanic airplanes at the opening session of the annual convention of the Lilienthal Association for Aeronautical Research at Munich, Germany.

Frank W. Caldwell, engineering manager, Hamilton Standard Propellers, East Hartford, Conn., made an address before the Congress on the second day of the meeting.

Obituaries

Harry R. McMahon

Harry R. McMahon, retired president of the Standard Steel Spring Co., Pittsburgh, Pa., died at his home in Coraopolis Heights, Pa., Oct. 3. He was 64 years old.

Mr. McMahon organized the Standard Steel Spring Co. in 1914 and had been its president until his retirement last year. In 1912 when he became a member of the SAE he was vice-president and general manager of Liggett Spring and Axle Co., with which he was associated for five years. Prior to that he had been assistant to the vice-president, Pittsburgh Coal Co., and assistant to the president of the Cleveland, Lorain & Wheeling Railroad, now part of the Baltimore and Ohio System.

Charles W. Svenson

Charles W. Svenson, mechanical superintendent in charge of drawing and designing, power plant and all mechanical operations throughout the entire plant of the Corbin Screw Corp., New Britain, Conn., died Sept. 25 at the age of 73.

Mr. Svenson was born in Sweden and served his apprenticeship in the machinist and toolmakers' trade with the Vulcan Match Co. before coming to this country in 1883. That year he joined the Corbin Screw Corp. as a toolmaker, starting his 54 years of continued service with them.

In 1921, when Mr. Svenson became a member of the Society, the manager of the company wrote, "His inventive genius is recognized in this section and in our line, and he fortunately combines with his inventive thought a practicability that is rather unique."

Mr. Svenson became a naturalized citizen of the United States in 1889.

Howard G. Young

Howard G. Young, general superintendent of automotive maintenance, Public Service Electric & Gas Co., Newark, N. J., since 1925, died at his home on Oct. 5 following a short illness. Mr. Young, who was 50 years old, had been associated with the automotive industry since 1905. In 1908 he was instructor for the Peerless Co., teaching owners and drivers. Then, for several years, he was tester and factory representative for the White Co.

During the World War he was with the United States Army in France, earning the commission of Captain, M.T.C., A.E.F., in charge of transportation and motor vehicle repairs. He rejoined the White Co. in 1919 and was branch service manager in Syracuse, Albany and Newark. In 1924 Mr. Young left White to join the Public Service Electric & Gas Co. He became a member of the SAE in 1927.

News of the Society

(*Continued from page* 16)

noted safety leaders of the city were present and the state administration was represented by Highway Commissioner Discus, an interested visitor to the meeting.

Mr. Michel made an earnest appeal for a greater attention to lamp service and adjustment, saying that he believes that not more than 40 per cent of the men in the industry keep the lamps of their cars in proper condition. Professor Jacklin suggested putting the driver farther forward and setting him ahead of the other front seat companions. He believes that the farther out front the driver is seated the better for vision and safety.

Mr. Creson graphically showed by use of slides that improvement in steering can be had by more accurate placing of the steering components by the chassis engineer, even without change of steering-gear design. His diagrams, charts and graphs gave a hint of the vast amount of research that is going on in the laboratories of some parts specialists.

Propane Used as Fuel For Railway Ice Engine

● Milwaukee

A new method of air conditioning railway passenger cars utilizing propane-fueled engines, was described Oct. 8 before the first 1937-1938 meeting of the Milwaukee Section by Lee W. Melcher, manager, refrigeration division, Waukesha Motor Co.

A railway ice engine has been developed by his company, Mr. Melcher stated, that offers numerous advantages over other methods of air conditioning. With this unit, he said, the frequent stops necessary in direct icing are avoided; cars are interchangeable, as is not the case when a power car is used, and there is no added load on the locomotive either by direct loss of steam from the boiler or by added drawbar load when the compressor is operated by a belt from the car axle. The Waukesha railway ice engine is an individual unit with its own powerplant for air conditioning each car.

Propane fuel was selected for this unit, Mr. Melcher stated, because of its high heat value, availability and safety. He pointed out that propane is a gas at atmospheric pressures, even at low temperatures, so that there is no danger of puddling in the event of an accident, thus reducing the hazard of fire.

The fact that the octane rating of propane is 125, he continued, allows the engine a high compression ratio of 8.8 to 1, with resulting economy. Mr. Melcher explained that the overall efficiency of the complete unit is such that 100 lb. of propane makes 5 tons of ice. Propane is compressed into tanks so as to become liquid, he stated, adding that each tank carries 100 lb. of fuel and that three tanks are sufficient for a round trip on overland trains.

Another advantage of propane for these engines, which go as many as 140 hr. without attention, according to the author, is that the fuel is a dry gas as received into the manifold, thus eliminating crankcase dilution and permitting extreme periods between oil changes. The problem of carbon in the combustion chamber is no problem, he added, stating also that propane is less expensive than other fuels.

Regarding mechanical features of the unit, Mr. Melcher told his listeners that due to schedules calling for 100 m.p.h. and over, conventional type fans had to be replaced by a screw-type specially developed for this service. The unit as a whole, he explained, is cushioned by rubber wheels which also serve to make the unit roll in and out on tracks under the car. One inch of sound-proofing material covers the unit and no noise from it reaches the interior of the car. The governing of the engine, he continued, incorporates the feature of changing the speed of the engine as well as turning it on and off which permits keeping the humidity down after the required temperature is reached, which could not be done if the engine were shut off completely.

Argue Military Use of Commercial Trucks

● Washington

The straight commercial truck, particularly of the light class, is far from a satisfactory military vehicle, declared Lieut. Col. J. H. Johnson, chief, motor transport branch, transportation division, office, Quartermaster General, speaking before the opening 1937-1938 session of the Washington Section. More than 125 members and guests, including 35 members of the Quartermaster Corps, Motor Transport School at Camp Holabird, Md., attended to hear Colonel Johnson present the Quartermaster side of "Commercial Motor Vehicles in the Military Service," and to hear Major John K. Christmas, chief of the automotive section, Office of Chief of Ordnance, give the Ordnance viewpoint on the same question.

Adding to the above statement, Colonel Johnson stated that whatever the deficiencies of the modern commercial truck are, it is the vehicle with which we must carry on any future war. "Our problem is to secure the most essential modifications in order to make as dependable a military transport as possible out of it," he declared, and he stressed the necessity of including provisions for multi-wheel drive in such modifications, stating that failure to do so would greatly handicap military operations in the field and might seriously endanger the successful outcome of any war.

The speaker predicts an urgent need, in case of war, for a standard $2\frac{1}{2}$ to 3-ton commercial class truck as a prime cargo and troop movement vehicle. "Why," he asked, "can't such a vehicle be provided through dimensional standardization of units now used in the construction of vehicles of this commercial class, which comprises two-thirds of the production of all medium and heavy classes?"

There are three basic elements involved in the procurement of commercial motor-vehicles in the face of a major emergency, Colonel Johnson said, enumerating them as follows: (1) Production of commercial vehicles to meet military requirements of type; (2) Modification of commercial vehicles to meet military requirements of service; (3) Standardization to insure satisfactory maintenance of motor-vehicles in the theatre of operations.

Each of these elements, he continued, presents problems relating to and affecting the others. These requirements might limit production, particularly during the early phases of mobilization, he declared, noting that on the other hand if the production capacity of the industry were depended upon alone, without consideration to the other aspects of the problem, vehicles might be produced that would be inadequate for service requirements and in such variety of makes and models as to make it impossible to satisfactorily maintain them in the theatre of operations.

Major Christmas, in presenting the Ordnance side of the problem, deplored the fact that the automotive industry produces no motor-vehicle which even approaches the modern tank, or can be reasonably modified or adapted as a tank. Although a tank is a special development carried on by the Ordnance Department, he remarked, many of its components are either of commercial origin or are special developments from related commercial automotive units. There are special parts, however, that the Ordnance Department must develop, such as high-speed tracks, steering, suspensions and armor plate; and then integrate and synthesize them with guns and armor into a complete fighting machine, he stated.

"Some idea of the problem," he said, "may be had from a comparison of a modern truck with its nearest commercial counterpart, a heavy commercial track-type tractor. The tank must have a top speed of from 25 to 50 m.p.h. as compared to 5 or 6 m.p.h. for the tractor; the tank carries a dead but 'payload' of armor amounting to 25 to 40 per cent of its gross weight while the tractor carries virtually nothing; the tank also must be capable of long fast movements over improved highways, carry two to five men, guns, ammunition, radio equipment and much else, as well as have a large built-in fuel capacity. This means that the tank must be built with narrow factors of safety, of highly efficient components using the finest steels and advanced heat treatments. Leading automotive firms who are supplying the Ordnance Department with tank components know how exacting these requirements are."

Major Christmas urged that forward-looking men of the automotive industry should take time off from their work now and then to look at what the cloistered military are doing in these piping times of peace. "More machines and fewer men will defend America the next time the bands play!" he declared at the conclusion of his paper.

B. B. Bachman, vice-president, Autocar Co., and Col. G. F. Jenks, chief, technical staff, Ordnance Department, were among those presenting discussion. Written comments of A. W. S. Herrington, president, Marmon-Herrington Co., who was unable to attend the meeting, were read by George E. Reynolds of the same company.

Clutches Face More Work Without Size Increase

● Canadian

Sporadic epidemics of sticking clutches, Chris Bockius told a questioner at the Sept. 15 meeting of the Canadian Section, are due to vacuum conditions. Condensation of oil and water vapor within the clutch bell housing have been the source of some of the ills to which modern clutches are a prey, he said. Mr. Bockius, who is development engineer, Raybestos-Manhattan, Inc., of Bridgeport, talked about "Why Clutches Get That Way."

He sketched the evolution of the clutch, but devoted most of his discussion to recent developments. Many problems have arisen, he said, in providing clutches which will function satisfactorily and stand the gaff of greatly increased torques with dimensions no greater than those used before the torque increases were made. It is difficult, he pointed out, to anticipate in a laboratory just what conditions the clutch will be subjected to in service by some drivers. He told of one clutch which was in practically

Field Editors

Baltimore – **Espy W. H. Williams**
Buffalo – **G. W. Miller**
Canadian – **Warren B. Hastings**
Chicago – **Austin W. Stromberg**
Cleveland – **William G. Piwonka**
Dayton – **Mearick Funkhouser**
Detroit – **William F. Sherman**
Indiana – **Herman Winkler**
Kansas City – **No Appointment**
Metropolitan – **Leslie Peat**
Milwaukee – **Theodore L. Swansen**
New England – **J. T. Sullivan**
No. California – **C. W. Spring**
Northwest – **R. J. Hutchinson**
Oregon—**J. Verne Savage**
Philadelphia – **H. E. Blank, Jr.**
Pittsburgh – **Murray Fahnestock**
St. Louis – **C. T. Schaefer**
So. California – **W. G. Chamberlin**
So. New England—**F. W. Mesinger**
Syracuse – **No Appointment**
Washington – **Capt. E. L. Cummings**

perfect condition after a test designed to duplicate 40,000 miles of normal field use, but which was rapidly ruined by a little lady weighing 90 lb. whose practice it was to race her engine while engaging the clutch and to ride her clutch in unmercifully. At the end of 1100 miles of her driving, he said, there was scarcely a part of the clutch worth salvaging.

Carrying research beyond computed torques to which clutches are assumed to be subjected, he concluded, reveals much data of use to technicians. He cited instances in which the theoretical projections and deductions were grotesquely at variance with fact, thus resulting in important revisions of formula and design.

Over 100 were in attendance at the meeting at which Section Chairman W. E. McGraw, Chrysler of Canada's chief engineer, presided.

German Transport Control Said Similar to I.C.C.

• Metropolitan

Germany has solved the problem of competition between railroad and motor transport by regimenting the latter under a strict federal administration, according to Dr. Ernst Esch, professor of motor transport science, University of Cologne. His address on Oct. 14 opened the season's technical sessions of the Metropolitan Section. Pointing out that the economic life of the nation depends upon using all transportation facilities to the utmost, Dr. Esch pointed to several parallels between the German plan and the administration of the Interstate Commerce Commission in this country.

"Of the 132,000 miles of Germany's road system, nearly 26,000 miles consist of the all-important main roads. Before the highway system was taken over by Chancellor Hitler's government, there were eighteen independent provincial regulatory bodies, a condition comparable with the 48 state administrators in the United States," he stated.

The Hitler election-promises of extending the highway-building, eliminating the annual registration fee on private cars, making drivers' licenses easier to obtain, simplifying the approval conditions for public transport vehicles, and encouraging the manufacture of motor-vehicles, have all been kept, Dr. Esch said.

Early after the present government took office in 1933 Hitler decreed that pedestrians were equally liable if involved in an automobile accident. "The motorist is no longer considered to be a wild animal," he said, adding that courts must take a different attitude in respect to a motorist's rights.

The rate-fixing function is one which has been given careful study by the administration, both Dr. Esch and Dr. Emil Merkert, a director of the motor transport bureau, pointed out. Although many of the tariffs are being revised from time to time, classifications of freight have been set up which are designed to allow railroads to carry certain types of goods at an advantage as compared with the motor transport. Generally, an attempt is being made to use motor transport for short hauls of freight easy to handle, while the railroads are for bulky, long-haul classifications.

Besides regulating long-distance motor transportation, the motor-vehicle administration has supervised construction of motor freight and passenger terminals, way-stations, restaurants and lodging facilities, garages, gasoline stations, insurance rates, and tariffs. Nearly 8,000 operators of 12,600 vehicles operate under the administration.

"We have found it just as important to prevent motor-vehicles from operating against themselves, as to prevent trucks and buses from cutting too deeply into the railroad traffic," Dr. Esch said.

Germany's foresight was praised by Hon. Joseph B. Eastman, I.C.C. commissioner; Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads – whose paper was read by L. I. Hewes; Pyke Johnson, vice-president, Automobile Manufacturers' Association, and John F. Winchester, Standard Oil Co. of N. J. All of these men discussed Dr. Esch's paper following a moving picture showing Germany's highway construction method.

Mr. MacDonald pointed out that 44 states are cooperating with the Federal Bureau of Roads in highway planning. An important function, he said, is to eliminate the "bottlenecks" around large cities throughout the country.

T. L. Preble, vice-chairman of the Section's Transportation and Maintenance Activity was in charge of arrangements, and Frederick C. Horner was chairman of the meeting.

3 Speakers Relate Motor History to Modern Cars

• Detroit

FOR one night recently Detroit's automobile engineers stepped away from 1938 and 1939 models to view again the cars of decades ago. The significance of early cars in the development of present types was the subject of the first Fall meeting of the Detroit Section at the Edison Institute, Dearborn, Mich., on Sept. 27. Three papers were presented by Ford Motor Co. engineers to an audience of more than 300 members of the Transportation Section of the Institute, following dinner at Dearborn Inn. Under the general subject, "The Evolution of the Automobile," L. S. Sheldrick discussed the development of engines and chassis; Henry R. Crecelius discussed body design and construction and R. H. McCarroll analyzed the development of automotive materials.

Because Mr. Sheldrick was convalescing from an operation for appendicitis, his paper was presented by F. L. Black, director of the Edison Institute. Illustrating his paper by reference to old cars on the floor of the Institute, Mr. Sheldrick demonstrated that automobile development began almost immediately following the invention of Cugnot's steam carriage in the latter part of the 18th Century. Restricted legislation, he said, held up their development in England from 1850 to 1896, although prior to 1850 for 50 years quite a number of steam cars were built and records covering their general design are available. In the United States, beginning about 1825, a number of steam cars were manufactured. An Austin steamer of the vintage of 1863 was exhibited along with an electric vehicle which attained the speed of a mile in 63 seconds in 1901. Germany, Mr.

Section Chairman Welcomes Speaker

Photo by Leslie Peat

Sydney G. Tilden, chairman, Metropolitan Section of the Society, welcoming Prof. Ernst Esch, University of Cologne, Germany, and a group of his students who arrived on the S.S. *Deutschland*. Dr. Esch, professor of Motor Transport Science, was the speaker at the first fall technical meeting of Met Section on Oct. 14. With the party are Dr. Karl Segler, Dr. Heinz Ropcke, and Dr. Emil Merkert, a German government highway transport official.

Left to right: August Wilhelm Bartels, Hans Adolf Esch, Franz Weiser, Werner Fricke, Hans Waldemar Artmann, F. H. Quadflieg, Wilhelm Busch, Paul Dorn, Karl Luther, Otto Heinz Bodenheim, Kurt Schwerdtfeger, Dr. Segler, Mr. Tilden, Dr. Esch, Alfred Erb, Claus Bartling, Kurt Creutzburg, Dr. Ropcke, Dr. Merkert, and Hans Georg Bachem.

Frederick C. Horner, General Motors Corp., was chairman of the meeting. Theodore L. Preble, Tide Water Associated Oil Co., is vice-chairman of the Met Section for Transportation and Maintenance.

Sheldrick said, proceeded meanwhile with the practical evolution of gasoline-driven cars.

The Brayton gasoline cycle, evolved in the 1850's, was followed in 1860 by Lenoir's practical gasoline engine which was installed in an automobile in May, 1862. Siegfried Marcus exhibited a gasoline-driven automobile at the Vienna Exposition in 1877 and, according to Mr. Sheldrick, this vehicle was equipped with high-tension ignition using a Rhumkorf coil of the same basic type as all ignition coils used today. Mr. Sheldrick also recalled that Beau de Rocha proposed the 4-stroke cycle in 1862 and that in 1876 Otto built a practical engine and obtained much of the credit for the cycle. Within 10 years after the Centennial Exposition in 1876, according to Mr. Sheldrick, all the elements of the gasoline engine were known, but steam cars continued in extensive use in the United States until about 1900 because steam was better known. Then, he said, the legislative restrictions heaped on steam cars changed the trend to gasoline engine cars, which were comparatively unrestricted, although in Europe horsepower taxes fostered the development of the so-called high-speed engine with bore-stroke ratios as high as four to one. Mr. Sheldrick gave credit to R. E. Olds, who was present in the audience, as the first to produce many cars of identically the same design.

Other stages in the development of cars at the turn of the century included the four-cylinder Franklin produced in 1903, the first en bloc cylinder casting by Chalmers and the 1905 Ford with four-cylinder engine and combined en bloc cylinders with crank case. The first Ford car with detachable cylinder head is on exhibition at the Institute. In 1906, Mr. Sheldrick said, there were 390 gasoline cars offered to prospects, in addition to 60 electric and 17 steam cars. An interesting point in connection with automotive development is that many of the features of recent cars were originally used many years ago, only to be abandoned or forgotten for a time, Mr. Sheldrick said. He urged anyone with a "new" idea to study early automobile design. The Eisenach, built in 1898 or 1899 and displayed in the exhibit, has independent front wheel suspension and manually controlled ratchet sprag to prevent its rolling backward down grade. The earliest V-8 engine in the exhibit is the de Dion V-8, produced about 1911.

Mr. Sheldrick's paper closed with a request for more information about some of the cars on exhibit. He expressed the hope that among the famous pioneers present some could add to the data available.

The styling of the first automobile bodies is attributable directly to the fact that the building of motor bodies was first conducted side by side with the building of horse-drawn vehicles, according to Mr. Crecelius. The only metal panels used in the first cars were in places where the panel could be perfectly flat or had to withstand heat. Beginning in 1905, a new school of thought in body building came to the top. The German Mercedes introduced this period. Mr. Crecelius said that the King of Belgium's "Tulip" design body was responsible for starting metal panel body construction. Thereafter there was no limit to shape, for everyone tried to lead in the use of reverse curves.

The next period, starting in 1910, showed a trend toward construction of wood with metal panels. Wealthy people, he said, had one automobile chassis with an open body for summer and a closed body for winter. Head room was plentiful. Women sat erect and wore high hats. In this period, windshields became standard equipment. Pierce-Arrow introduced the first all-metal body, according to Mr. Crecelius. It was of aluminum, cast in sections which were riveted together. The entire doors were cast, as were many of the moldings. The cast sections, he said, were very thin and required careful casting.

The greatest step in body design development from 1910-1915 was made by Van Der Plas of Brussels. He really had style and changed the whole conception of body appearance, both externally and internally. His bodies had low head room, deep cushions, sloping roof, mahogany interiors and new body lines, including cowl and foredoors. High dashes, flush sides, front doors and smooth appearance were featured in auto show cars. Brewster also built a sloping windshield with triangular side shields on an enclosed drive sedan about 1912. Up to this time no great attempt was made to enclose the driver with glass doors, nor were any enclosed sedans made to speak of. Dodge "all-steel" body construction was begun by Budd at about this time.

The construction of new designs was curtailed during the war period and immediately after the war the delivery situation on new cars was so acute that old models were continued in production for some time. Then followed for a short time the fabric-covered body and the first attempt to provide body silence both in the construction of the body and in its mounting on rubber. To the late Amos Northup, Mr. Crecelius gave credit for the first attempt to America to design an automobile body as a complete unit with fenders, hood, radiator shield, etc., on the Reo Royale. In no small degree, according to Mr. Crecelius,

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Metropolitan Section - Regional

Transportation & Maintenance Meeting

Nov. 9 & 10 **Robert Treat Hotel** **Newark, N. J.**

Sponsored by the Metropolitan Section with the cooperation of the Philadelphia and Southern New England Sections

T. L. Preble, *General Chairman*

Tuesday, Nov. 9

3:00 P.M. **Bus Maintenance Symposium**

Carl Stocks, *Chairman*

Brakes – Can They Take It? – Chris Bockius and John Bassett, Raybestos-Manhattan, Inc.

Reduction of Recurring Failures – J. H. Middlekamp, Brooklyn Bus Corp.

Fleet History as a Guide to Maintenance – William J. Cumming, general superintendent, Surface Transportation Corp.

8:00 P.M. **Merrill C. Horine, *Chairman***

Truck Problems in Tunnel Operation – Billings Wilson, assistant general manager, The Port of New York Authority.

Trends in Truck Design – Joseph A. Anglada, consulting engineer, New York.

Wednesday, Nov. 10

3:00 P.M. **T. L. Preble, *Chairman***

Economics of Truck Selection – F. K. Glynn, engineer, American Telephone & Telegraph Co.

8:00 P.M. **George T. Hook, *Chairman***

Semi-Trailers vs. Six-Wheelers – John G. Moxey, Transportation Engineer, Sun Oil Co.

National Motor Truck Show
is being held in Newark
Nov. 6 to 12

West Coast Section - Regional

Transportation & Maintenance Meeting

Nov. 18 & 19 **Fairmont Hotel** **San Francisco**

Sponsored by the Northern California, Northwest, Oregon and Southern California Sections, and the SAE Club of Denver, with the cooperation of the Transportation and Maintenance and the Truck, Bus and Railcar Activities

Thursday, Nov. 18

9:30 A.M. **Railcar & Highway Session**

J. V. Savage, *Chairman*

Introductory Remarks – S. B. Shaw, General Chairman.

Maintenance of Streamliner – *City of San Francisco* – E. B. Dailey, engineer, car construction, Southern Pacific Co.

Economics of Highway Design – C. H. Purcell, state highway engineer, California Department of Public Works.

12:15 P.M. **Luncheon**

A. H. LauFer, *Chairman*

Speaker – F. C. Patton, manager, Los Angeles Motor Coach Co.

2:00 P.M. **Maintenance Session**

W. W. Churchill, *Chairman*

Motor Coach, Maintenance Problems – R. M. Ahrens, general superintendent of maintenance and equipment, Pacific Greyhound Lines, Inc.

6:30 P.M. **Banquet**

G. L. Neely, *Chairman*

Friday, Nov. 19

10:00 A.M. **Safety Session**

C. J. Vogt, *Chairman*

Drivers' Tests – Paul Mason, California Department of Motor Vehicles.

The Performance of Automotive Lighting Devices – L. M. K. Boelter and W. R. Sharkey, Jr., University of California.

12:15 P.M. **Luncheon**

W. B. Birren, *Chairman*

Speaker – L. V. Newton, vice-president in charge of operation and maintenance, Market Street Railway Co.

2:00 P.M. **Operation Session**

E. W. Templin, *Chairman*

Committee

S. B. Shaw, *General Chairman*

F. C. Patton	W. W. Churchill
J. V. Savage	E. W. Templin
G. N. Gromer	E. C. Wood

the great difference between early and present-day construction is attributable to improvement in body building materials. "For instance," he said, "the all-steel body could not have been attained without the development of suitable sheet steels or without great progress in welding practices, die-making and manufacturing methods."

Mr. McCarroll emphasized this by stating "We believe that if it had been possible to build a car like the present Ford Tudor in 1910, the materials then available would have made it weigh about twice as much as the 1937 model or if this had been attempted in 1900, the car would have weighed three times as much." First steel specifications for automotive parts were written in 1905. Up to 1907 there was little use of types other than low carbon, machine steel, spring steel and tool steel, and these were of non-uniform and poor quality, judged by standards later developed. From 1903 to 1907 only non-alloyed unheat-treated steels were used in Ford cars, the first heat-treated part and the first truly alloyed steel being incorporated in the 1907 Model T. There are now used by the Ford company about 50 types of steel for automobile parts, each having an exactly specified treatment to produce necessary physical properties.

His analysis of the amounts of different materials used in automobile construction showed 1919 lb. of steel in each finished car including 149 lb. of copper silicon steel castings. About 357 lb. of cast gray iron and 36 lb. of cast malleable iron, 70 lb. of rubber used in more than 200 rubber parts, 3½ lb. of wool and mohair, and 51 lb. of glass are used in the average car. Discussing the use of nonferrous metals, he added the following figures showing the amounts used per car:

Copper	34 lb.	Tin	4 lb.
Lead	31.5 lb.	Chromium	2.8 lb.
Zinc	14.5 lb.	Antimony	1.5 lb.
Manganese	14.5 lb.	Nickel	0.8 lb.
Aluminum	10.6 lb.	Cadmium	0.7 lb.

Attendance included more men after whom automobiles have been named than any automotive gathering in many years. At the speakers' table, for example, were Alanson P. Brush, R. E. Olds, Louis Chevrolet, W. B. Stout and Ray Harroun.

Henry Ford, who was the first vice-president of the SAE, joined guests while they inspected the historical display before the session actually started.

Other veterans of the industry who attended the meeting included: Col. J. G. Vincent, Col. H. W. Alden, J. G. Rumney, W. R. Strickland, G. C. Brown, W. B. Mayo, Mason P. Rumney, J. E. Schipper, T. P. Chase, L. K. Snell, P. L. Tenney, J. H. Hunt, R. H. Upson, N. E. Hendrickson, Victor Gauvreau, C. E. Broders, V. R. Heftler, Porter Stone, Walter Keys, C. W. Stringer, Roscoe Hoffman, W. N. Booth, L. W. Longan and Walter Fishleigh.

A.A.M.V.A. Approves SAE Trailer Standards Work

The American Association of Motor Vehicle Administrators, at its annual convention in Cincinnati last month, adopted a recommendation of its Trailer Coach Committee, that hitch "specifications regarding strength of materials and type of joint shall conform to the recommendation of the Society of Automotive Engineers when said specification has been formulated."

Fuels and Ignition at Two September Sessions

● Northwest

The search for an agent which would raise the compression ignition point of gasoline without producing harmful effects, resulted in the adoption of the octane scale of rating antiknock value, A. D. Martin, Ethyl Gasoline Corp., stated on Sept. 3 at the first of two September meetings held by the Northwest Section. At the second meeting on Sept. 17, C. K. Mosey, of Mosey & Mosey, Inc., made a thorough analysis of the relation of the coil and the condenser to one another.

Mr. Martin in his talk reviewed the early days of fuel research and the discovery of detonation and described the long search which led to the now widespread use of tetraethyl lead. He dis-

Two Additional Sections Announce 1937-38 Officers

(Other 1937-1938 Section Officers are listed in the September SAE Journal.)

● Dayton

Chairman: L. F. Poock, vice-president, Sheffield Gage Co.; vice-chairman: K. W. Stinson, professor, automotive engineering, Ohio State University; vice-chairman for Cincinnati District: W. W. Tangeman, vice-president, Cincinnati Milling Machine & Cincinnati Grinders, Inc.; treasurer: E. S. Patch, vice-president, Moraine Products Division, General Motors Corp.; secretary: William S. Wolfram, engineer, Inland Mfg. Co.

● Southern California

Chairman: W. B. Birren, western representative, Wright Aeronautical Corp.; vice-chairman for Aeronautics: Carleton E. Stryker, chief engineer, instructor, Curtiss-Wright Technical Institute; vice-chairman – Automotive: Stanley Whitworth, vice-president, charge production, Studebaker Pacific Corp.; vice-chairman for Fuels and Lubricants: Claude E. Emmons, engineering chemist, Texas Co.; vice-chairman for Transportation and Maintenance: H. E. Clemens, superintendent maintenance, Southern California Freight Lines; treasurer: Fred C. Patton, superintendent manager transportation, Los Angeles Railway Corp., manager, Los Angeles Motor Coach Co.; secretary: Carl Abell, field representative, Ethyl Gasoline Corp.

"If a standard coil is used with a heavy-duty condenser of 0.35 mfd., the coil surge will be too low to fully cover or charge the condenser plate and will produce sluggish ignition with a tip forming on the negative point.

"Heavy-duty coils used with a standard condenser of 0.24 mfd. will produce too high a surge, points will arc, and the forming of a tip will be noticed on the positive point.

"Pre-heating of coils should be discouraged; they should be tested at driving heat. The practice of coil pre-heating has ruined many good coils."

Contrasts Old and New Maintenance Methods

● New England

Recalling the days when most automotive repair work was done by guesswork and automobile manufacturers felt that their job was done when they passed the cars on to dealers, Glenn S. Whitham, general manager and director, Charles Street Garage Co., Boston, addressed the opening meeting of the New England Section, Oct. 14, at Hunt Marquardt, Inc., Boston. He was introduced by Section Chairman John H. Walsh.

There is a different atmosphere today, Mr. Whitham declared. Factories now train men to go into the field and instruct their dealers' servicemen, and dealers have established up-to-the-minute repair departments equipped with modern equipment, he explained, adding that this results in lower labor cost and better jobs done in less time.

At the close of Mr. Whitham's talk the meeting adjourned to a motor clinic in the same building where members saw the latest in shop equipment in actual operation. The demonstration included cleaning of engines and chassis by chemical vapor; straightening of dented doors, panels and bodies by hydraulic machines; spray painting; oiling and greasing.

Maintenance Program Opens Section Season

● Buffalo

Henry Jennings, technical editor, *Commercial Car Journal*, brought members and guests of the Buffalo Section the latest information on special equipment for maintaining commercial fleets at the Section's opening meeting, Oct. 12. He likewise spoke on difficulties encountered due to unusual hauling conditions, and methods operators have used in meeting them, as well as on systems for maintaining scattered fleets.

Discussion following the meeting touched on a number of subjects, including tire mileage, I.C.C. rules and regulations, and the variation in state laws covering inter-state transportation.

Stout Sky Car to Detroit U.

The original Stout Sky Car Airplane was presented to the Aeronautics Department of the University of Detroit on Sept. 20 by William B. Stout, past-president of the SAE and president of the Stout Engineering Laboratories. This airplane has been placed in the General Laboratory of the Engineering College and will be used for student design studies and student laboratory experiments.

played engine parts which had been damaged or made unserviceable by a number of causes, each part being labeled with the name of the engine and the cause of failure. Motion pictures of the combustion process, taken with a specially-developed camera through Ethyl's famous "quartz window," were shown, and those present were actually able to see the effect of detonation on flame propagation.

Demonstrations were given with a single-cylinder, air-cooled demonstration engine and with a complete car operating on a chassis dynamometer under various service conditions.

Talking on "Coil and Condenser Relationship," Mr. Mosey discussed each unit in the automobile ignition system, and concluded with demonstrations of several pieces of electrical test equipment. He said in part:

"Spark coils are pulsating transformers having a low and high-voltage primary and secondary cycle, the cycle and frequency controlled by the speed of the distributor cam.

"A coil's surge depends upon the type of iron used for its core, the size and number of turns of wire on both primary and secondary, the choking effect of the secondary upon the primary, and the inductance milliampere output of the secondary. A condenser must have enough square inches of surface to receive all of the secondary surge; otherwise, point trouble will develop.

"A standard coil will have a surge voltage of approximately 400 volts at idling speed. Point dwell will cause this voltage to drop to 200 volts or less at high speed. Standard coils for average speed of idle to 20 m.p.h. will require a condenser of 0.27 mfd., or medium; 15 to 45 m.p.h. will require a condenser of 0.22 mfd., or high-speed. For higher speed than 65 m.p.h., standard coils should be replaced with a greater secondary output coil.

"When coils and condensers are balanced for high speed, they will be out of balance at low speed.

Aircraft Production Meeting

(*Continued from page* 14)

the drag that is subject to control is determined by the flow out of the cowl exit. He gave particular attention to the "nose slot" cowling, a recent N.A.C.A. development that gives promise of improved cooling at low speeds.

Mr. Wood arrived in time to attend a later session at which he replied to written discussion offered by Harman H. Ellerbrock, Jr.; Oscar W. Schey and Benjamin Pinkel, all of the N.A.C.A.

I. L. Shogran, of the Douglas Co., presided at the afternoon session. The opening paper, "Engine Maintenance from the Operator's Viewpoint," prepared by W. A. Hamilton, Transcontinental & Western Air, was read by J. W. Vale, Jr., of the same company. The development of accurate and dependable automatic controls affecting engine conditions, which formerly occupied most of the pilot's attention in the air, and the great advance in engine design and material, Mr. Hamilton stated, have definitely made possible the tremendous increases in power output per weight and cylinder displacement brought about in the past five years. These greater output demands upon modern engines, strangely enough do not require added inspection or service, he continued, also stating that the number of hours between various inspections and service operations have even been increased.

In the second afternoon paper Robert E. Johnson, Wright Aeronautical Corp., who has traveled some 100,000 miles standing up on test flights, defined a successful aircraft installation as one which safely, economically and reliably permits the development of the maximum efficiency of the engine-airplane combination under any operating condition for which the airplane is designed. He takes the airplane designer to task because in his enthusiasm to decrease drag he often does so at the expense of power.

At the call for discussion Charles F. McReynolds, *Aviation*, suggested that the engine manufacturer should build the engine-nacelle unit from the fire wall forward. This was seconded by T. P. Wright, Curtiss-Wright Corp., who added that although engine builders make rules, the airplane manufacturers generally do not follow them and trouble results.

Engine manufacturers have considered building complete units, Mr. Johnson explained, but have found numerous complications in that no two airplane makers will put attachment studs in the same locations, and that each has his own idea of auxiliary equipment. Dr. Klein added that no two airplanes are designed for same load factors.

W. L. Howland, research assistant, California Institute of Technology, was joined by Mr. Vale and Mr. Wright in discussion of oil system design, which Mr. Johnson stressed in his paper.

Probably the oldest living aeronautical engineer, E. R. Hewitt, a founder member of the American Society of Aeronautic Engineers which amalgamated with the SAE in 1916, and a member of the SAE since 1910, talked as an added attraction at the evening session. Introduced by Dr. Klein, who presided, he reminisced upon his early association with Dr. Hiram Maxim. During his summer vacations from college in 1889 and 1890 he worked with Dr. Maxim in developing a steam-powered airplane, believed the first ever to get into the air. "Judging from the progress made in my lifetime you fellows have no idea how far you are going," he concluded.

Advances in stainless steel, shot welding and other phases of its production were related by Col. E. J. W. Ragsdale, chief engineer, E. G. Budd Manufacturing Co., who forecasts a switch from the lighter alloys to stainless steel in the aircraft field.

He stressed that in its use, as in the use of any other metal, it must first be engineered for the structure and the structure then engineered

for production. This, he added, has not been completely done for aviation although the way is pretty well defined.

Asked by Paul K. Beemer, C. T. Hill Co., if Budd uses the new stainless steel eliminating chromium carbide precipitation, Col. Ragsdale explained that Budd welds so fast that precipitation does not take place. For arc-welding, he added, a stabilized steel is necessary.

System in an aircraft-factory was well outlined by Eric Springer, assistant factory manager of Douglas Aircraft, who explained his company's method of production control. In discussion he particularly stressed the necessity of installing a production-control system early in the life of a plant, stating "there is the deuce to pay if you wait until you are large before putting one in force." He also warned of the danger in letting such a system get top heavy.

Fresh from the inspection trip through California Institute of Technology Friday morning, the engineers devoted the afternoon session to aircraft materials.

Maj. Joseph L. Stromme, of the Air Corps, gave basis for belief that should the United States face war in the future we will not be in the same unprepared condition that we were in 1917. Waste during the World War, because of the lack of proper planning, reached a total of $5,000,000,000, he declared.

Charged by Congress with the "supervision of the procurement of all military supplies and other business of the War Department pertaining thereto, and the assurance of adequate provisions for the mobilization of material and industrial organizations essential to the war time needs," the Assistant Secretary of War is organizing industry in a program of industrial preparedness. The aim is to "insure an uninterrupted flow of raw material from the mine or forest to the factory, and from the factory to the front, avoiding bottle-necks and eliminating profiteering," Major Stromme declared, adding "already over 20,000 manufacturing establishments have been enlisted in our efforts."

This work, he emphasized, indicates no desire for war, "it is simply setting our house in order for a catastrophe that we hope will never overtake us."

In the absence of Kent R. Van Horn and Howard J. Heath, Aluminum Co. of America, their paper, "Quality Control of Aluminum Alloy Aircraft Castings," was read by T. D. Stay, technical director, foundry division of the same company. Enumerating the structural variations, such as solidification shrinkage, blowholes, cold shuts, gas porosity, segregation and cracks that affect the strength and serviceability of sand castings, the authors described methods of inspecting and controlling these discontinuities. They likewise stressed the service record of properly controlled and inspected aluminum-alloy castings.

The industry's interest in magnesium castings was evidenced by the discussion which followed W. G. Harvey's (American Magnesium Corp.) paper on the subject.

Mr. Harvey, in answer to a question by Mr. Wright, chairman of the session, predicted adoption of hot-pressed propeller blades within the next two years. Mr. McReynolds asked about forming magnesium sheet. Mr. Harvey replied that while it is difficult to form magnesium sheet or extrusions cold, magnesium forms better hot (at about 600 deg. fahr.) than aluminum does cold. He added that magnesium sheet is extensively used in Europe. Answering a question by Lieut. H. K. Perrill, the speaker stated that increasing corrosion resistance is "project No. 1 of the industry." Throughout his paper and discussion Mr. Harvey stressed the advantages of magnesium alloys and frankly set forth their limitations.

Plastics are finding extensive use in airplanes,

Candid Shots at the Aircraft Production Meeting

Photos by W. G. Chamberlin, Field Editor, Southern California Section

1. Four members of the Southern California Section: Melvin N. Lefler, *left*, secretary last year, sits with two Section past-chairmen, R. N. Reinhard, *front*, and L. J. Grunder, *back*, and Ellis W. Templin, past-chairman of the Philadelphia Section, who is now located in Los Angeles.

2. Hugh W. Coburn, *left*, Western Air Express, represented the Air Transport Association of America. With him are SAE President Harry T. Woolson and W. C. Clayton, engineering executive, Aeronautical Chamber of Commerce of America.

3. Hall L. Hibbard, chairman of the Processes Session, Carleton Stryker, general chairman of the meeting, and Donald H. Wood, author of an opening session paper.

4. Past-President William B. Stout and SAE General Manager John A. C. Warner chat for a moment before a session gets under way.

5. W. B. Birren, Southern California Section chairman, extends the Section's welcome at the banquet.

6. I. L. Shogran, chairman of the Engine Operation and Maintenance Session, R. E. Johnson, speaker, and T. P. Wright, Materials Session chairman, face the camera.

7. Dr. Oscar C. Bridgeman, National Bureau of Standards, and Carl Abell, secretary of the Southern California Section, look over some meeting pictures.

and G. P. Young, Röhm & Hass Co. chemist, explained these applications in his paper presented at the Friday evening session. He also described future possible applications.

In the other Friday evening papers C. R. deLaubenfels, research engineer, Lockheed Aircraft Corp., spoke on "Drop-Hammer Applications," and M. J. Chapman, standards engineer, Douglas Aircraft Co., gave discussion on die castings. Hall L. Hibbard, vice-president and chief engineer, Lockheed Aircraft Corp., presided.

Mr. deLaubenfels expressed his belief that drop hammers would be more in use if designers knew more about them. Advantages of drop hammers, he stated, include: (1) fabrication of uniform and interchangeable parts; (2) reduction of number of parts; (3) reduction of fabricating operations; (4) improved strength; (5) decreased weight, and (6) lower cost.

Mr. Stryker, L. D. Bonham of Lockheed, Fred P. Laudan of Boeing and Edmund T. Price of Solar Aircraft, were among those contributing to the discussion which included suggestions to avoid deterioration of zinc reclaimed from dies by using steel instead of iron pots; also that the use of aluminum for female dies has the advantages of lasting longer and being easier to handle than zinc female dies.

Aluminum alloy die castings have come so far to the front in the past year, declared Mr. Chapman, that it is now considered a standard method at the Douglas Co. The beauty of the process is that it permits production of small castings (from few ounces to several pounds) in large quantities at a low cost. Intricate shapes, he added, can be produced with commercial tolerances maintained on most dimensions with resultant saving on finish cost.

The Army, the Navy and Pan-American Airways were represented by speakers introduced by Lieutenant Perrill who chairmanned the Saturday morning maintenance session. Maj. Joseph T. Morris, chief engineering officer, Rockwell Air Depot, gave a detailed analysis of the Air Corps system of depot maintenance. He emphasized the necessity of keeping airplanes as simple as possible from the angle of repair, overhaul and maintenance and making parts most often damaged interchangeable and easy to replace. He looks to designers to provide better cooling, particularly on the ground and expects the Air Corps to benefit from the indicated swing toward powerplant installations rather than engines and accessories.

Maj. Grandison Gardner of March Field added to Major Morris's comments by speaking particularly of maintenance in the field. One of the greatest problems in times of peace and prosperity, he declared, is to obtain and keep good men. "As soon as a man develops to the quality standard we need he is worth more to commercial activities than he can be paid in the Army, so leaves at his first opportunity," he said.

This is true only of operating units as the depots hire skilled workmen through Civil Service at rates of pay which compare favorably with those paid by commercial agencies, Major Gardner added.

Corrosion Bugbear to Naval Aircraft

The Navy picture was given by Fred G. Arnold, chief engineer, U. S. Naval Air Station, San Diego, who listed numerous examples to indicate that designers of Naval Aircraft do not think ahead of "immediate usefulness," give little thought to future maintenance and less to overhaul.

The primary bugbear to Naval aircraft is corrosion, Mr. Arnold declared, adding that thoughtfulness of the designer in eliminating corrosion hazards cannot be emphasized too strongly. He also stressed the importance of manufacturers furnishing accurate charts or diagrams of fitting and member design loads as well as clear, complete and accurate drawings of the ship.

To this, John J. Hospers, Chance Vought Aircraft, made the further suggestion that the erection and maintenance manuals furnished to the base should be complete in every detail as they are often the only sources of information that the aircraft squadrons have to fall back on.

Using many colored slides F. C. Leslie, Pan-American Airways, showed facilities for maintenance of their transoceanic ships at Alameda, Calif. Due to delays in construction of municipal airports he said, his company has constructed several temporary maintenance bases, one of which is the Alameda base. These temporary bases, he believes, should be particularly interesting to the Navy from a defense angle.

Comparison of American and European factory equipment made the closing session, Saturday afternoon, of particular interest to production men. E. J. Rivers of North American Aviation was in the chair.

D. M. Carpenter, production manager of Consolidated Aircraft Corp., presented the opening paper, discussion of which was answered by J. W. Van Doren, of the same company.

Stressing the comparatively small production lots in which airplanes are produced and the relatively small budgets for production equipment, Mr. Carpenter states that a factory executive must be constantly on the alert not to let his knowledge of mass production run away with him. He pictures production as a three-ring circus with the customer in one ring, the engineer in the second and the shop in the third; each with conflicting ideas. Changes predominate and production equipment must be flexible. Production of most aircraft parts, he declared, may be boiled down to cutting, forming, fastening and finishing. He particularly described tools, used by his company, for these applications.

What Europe is doing in aircraft production was emphatically pictured by Henry A. Berliner, president, Engineering and Research Corp., Washington.

First, he said, aircraft, particularly military aircraft, are being produced on a scale far beyond what has been attempted in this country; second, that necessity of getting into production rapidly in some countries has brought aircraft manufacturers large direct and indirect subsidies; and third, that there is a lack of skilled workmen due to the economic demand for aircraft mechanics.

In this country, Mr. Berliner believes, workmanship on aircraft is better than that of any other nation due to a higher proportion of skilled labor and better material. American design is better and assembly time is less, he declared, but, generally speaking, the more advanced European countries are producing component parts of aircraft more rapidly than we do, because of better equipment.

Mr. Berliner showed pictures and described several outstanding pieces of production equipment in use on the other side that have not been utilized to any extent in America.

Discussion time was taken by representatives of the foremost American companies desiring more detailed information regarding this equipment.

Tulsa F. & L. Meeting

(Continued from page 15)

Diesel operation," he concluded, "they must at the outset recognize along with its many advantages its limitations, and must learn to live with the Diesel engines the same as they learned to live with gasoline engines in the early days of their operation."

A. W. S. Herrington, Marmon-Herrington Co., talked from notes about the recent development of super-trucks for geophysical purposes in exploration over a wide range of topographical conditions.

In a paper which is scheduled for publication in an early issue of the SAE JOURNAL, Floyd Patras, Southwestern Greyhound Lines, Inc., traced the growth of bus maintenance from its early stages of haphazard repairs down to modern methods of cost keeping, predictions of service expectancy of various units, and systematic maintenance. Referring to the methods used in his own organization, Mr. Patras said: "When a new bus is received from the manufacturer, an identifying number is stamped on each unit and each major part. A card is made out for the files covering each numbered unit or part and notation made of the number, make and model, date of service, etc. When any unit is removed for any reason whatever, a notation is made on the card showing the date, garage, reason for removal, new parts used in overhauling it, and service miles rendered. Complete performance information is now available concerning not only every unit assembly, but also nearly every part."

Young Talks on Engine Cooling

For engine jacket water cooling, there have been developed many different types of comparatively light-weight units even in the shell-and-bundle type heat exchangers, as well as convection-type radiator coolers in various and sundry types, Fred M. Young, president, Young Radiator Co., pointed out in an interesting paper on "Engine Cooling Problems." The conventional automotive type radiator becomes a convection unit, which transfers the heat by the wiping of the surface, he said. By means of slides, Mr. Young went on to classify and describe the wide range of heat-transfer products involved in engine jacket cooling, in cooling of the engine from the inside by forcing oil to various moving parts of the engine, and in the use of heat exchangers for cooling oil. He made considerable effort to point out developments of the past few years and the relation of design features and materials to operating results and production methods.

Mr. Young noted the need for correct nomenclature for this supplemental equipment and described and defined various types. He concluded by emphasizing that "the wide range of cooling products, while apparently unrelated from an appearance standpoint, actually manifests great similarity in research, design, and arrangements in a very interesting manner. . . . By more intensive work in the future, still greater improvements may be anticipated."

The paper entitled "Some Improvements Relating to Seasonal Gasoline and Lubricating Oil" by R. C. Alden and D. G. Proudfoot, Phillips Petroleum Co., included a comprehensive survey of volatility characteristics of Midwest gasolines, previously reported for 1929-1934 inclusive, but now extended up to and including the second quarter of 1937.

The outstanding fact demonstrated by this survey, the authors contended, is the rapidly increasing use of wide seasonal variations at the midpoint of the distillation curve. Histories of three major house-brand gasolines were presented to confirm this point. Seasonal control of front-end volatility has been practically unchanged for the duration of the survey, the authors pointed out, except for a continuing slow increase in vapor pressure and minor variations in seasonal factors. There are growing evidences of some seasonal control at the 90 per cent distillation temperature.

Climatic studies pertaining to mean minimum temperatures were presented to illustrate their application to putting seasonal oil changes on a calendar basis, thus removing considerable uncertainty as compared to previous practice.

Prominent Personalities at Tulsa Fuels & Lubricants Session

(Left to right)
R. D. Best
H. D. Hill
C. L. Cummins
J. V. Brazier

A. F. Campbell

F. M. Young

(Left to right)
A. W. S. Herrington
O. C. Bridgeman
D. G. Proudfoot
Richard Stansfield
B. E. Sibley

Written discussion of this paper submitted by T. A. Boyd, General Motors Corp., referred to the following statement made by Henry M. Crane in the SAE Journal in 1923: "The conclusion was that high volumetric efficiency is incompatible with the best use of heavy fuels; that better results are obtainable with lighter than with heavier fuels in cars adapted to lighter fuels, but that in cars adapted to heavier fuels the use of lighter ones gives no advantage." Subsequent events, Mr. Boyd pointed out, in which fuels have gradually become more volatile and in which cars have simultaneously been modified so as to reduce mixture heating and, at the same time, to improve volumetric efficiency and power per cubic inch, have abundantly demonstrated the soundness of this conclusion drawn by Mr. Crane from early C.F.R. tests.

H. C. Mougey in written discussion voiced the opinion that "the oil industry appears to be in a better position to handle the gasoline problem than the oil problem since, over a large part of the temperature range, the public have their choice of oils of two or more different viscosity classifications." He lauded educational work such as that done by the authors in this paper.

Robert D. Best, Continental Oil Co., brought before Diesel operators the properties of fuels which are known to be significant in his paper "Essentials of Fuel Utilization in Diesel Engines of the Automotive Type." The relation of ignition quality to efficiency he showed to be slight and then discussed the need for a high mean effective pressure together with the means for its attainment. He explained, in conclusion, the dependence of various variables to one another.

In the concluding paper of the technical sessions on Friday, preceding the debate which ended the meeting, Mac Short, AiRover Co., reviewed the improvements which have been made in private-owner airplanes during the last few years and described many new devices which help to make such planes better, more efficient, and safer.

Chicago T. & M. Meeting

(Continued from page 15)

weight method as a basis for taxing. Mr. Schon pointed out, the majority still require a payload tonnage rating for licensing purposes.

"If we had uniformity in truck usage," said Mr. Schon, "the problem would be quite simple, but the infinite variety of vocational applications and operating conditions cannot be covered with either a definitely fixed payload or a fixed gross vehicle weight rating. In meeting the operators' demands for a multiplicity of different vehicles, the full-line manufacturer doing a world-wide business has problems to face vastly different from those confronting the operator who is only interested in his own transportation needs, quite often involving the delivery of only one particular kind of merchandise."

Preference for ratings on a maximum gross-weight rating basis combined with a definite performance factor which could be agreed upon by the industry, was set forth by Thomas Carney, International Harvester Co., in a prepared discussion. "This combination of weight and performance has been favorably received by automotive and safety engineers," he said. "This will, we believe, be at least an initial step toward providing the operator with data on which he can make a reasonable comparison between various makes of vehicles. Furthermore, it will give the designer a little more definite target at which to aim than he has had in the past."

Other discussers of Mr. Faulkner's paper included: A. J. Scaife, Autocar Co.; Robert Cass, White Co.; and C. W. Kynoch, Dodge Division of Chrysler Corp.

At the dinner session, Wednesday evening, C. A. Crowley, director of research, Technical Service Bureau, presented a paper illustrated by slides on "Evaluation of Extreme-Pressure Lubricants" prepared jointly by himself and F. A. Faville, president Faville-LeVally Corp. The authors, in a carefully prepared study of machine testing procedure, set forth how E-P lubricants may eventually be machine-tested and the resultant laboratory findings correlated with results compiled from service data. Machine testing of lubricants, the authors stated, offers a method of evaluating anti-scuffing or anti-weld values and the wear value of the lubricant as well. Load carrying capacity of lubricants, it was explained, may be raised to the point where they will withstand scuffing, but as this may be accompanied by prohibitive wear, it is important in evaluating anti-weld characteristics to give this factor proper consideration.

Laboratory testing which evaluates through a reproducible method both wear value and anti-scuffing value is hence most desirable, they said. Final seizures, it was demonstrated by the authors, definitely indicate no rational relation to either of the aforementioned values or to service performance. Machine testing, they added, is therefore important as a means of establishing control standards that approximate in close degree the findings from actual service. Correlation of test machine findings with service data in the field will provide standards of measurement by which to eliminate inferior lubricants, the authors declared.

An example of need for such correlation is cited in the fleet operation field on the question of whether or not lead soap sulphur lubricant contributes to abnormal wear, they stated, noting that one operator of a large fleet utilizing the back-lash method of measuring wear declares the method is unreliable. He contends, the authors point out, that laboratory findings are essential to satisfactory solution of the problem.

Discussion of several points in the Crowley-Faville paper were presented by E. R. Barnard, Standard Oil Co. of Ind., and prepared discussions were offered by: T. B. Rendel, Shell Petroleum Corp., whose paper was read by H. R. Kemmerer and J. A. Moller, Pure Oil Co.,

whose discussion was presented by H. L. Moir. Comments by C. W. Georgi, Enterprise Oil Co., Inc.; F. L. Miller, Standard Oil Development Co.; H. C. Mougey, General Motors Corp. and Geo. G. Hanson, The Murray Corp., were read by Chairman Faulkner. Further discussion from the floor followed, with E. A. Harper, Texas Co., and H. L. Debbink, Milwaukee Electric Railway & Light Co., being among the principal commentators.

That air conditioning of automobiles is very definitely on the way was indicated by a highly interesting paper, "Automotive Air Conditioning," presented by R. F. Norris, C. F. Burgess Laboratories, Inc., Thursday morning. Reviewing the progress made by railroads in air conditioning, Mr. Norris, who was introduced by Harry O. Mathews, chairman, pointed out that this subject, while just beginning to get attention, is in a fair way of being solved for automobiles despite space limitations and installation difficulties.

Minimum fresh air requirements of 25 cu. ft. per min. per passenger, or 125 cu. ft. per min. for a 5-passenger car, must be provided, Mr. Norris declared, adding that for comfort twice this amount is advisable. To distribute this air without draft requires a special fan system, and for summer the air must be cooled, he said. Filtering of air by means of air filters of the oil filament type and a forced draft system are also required the author declared. Sealing of car windows, as in air-conditioned railroad cars and airplanes, is another eventual requirement for the properly air-conditioned car, Mr. Norris stated. Power for operating this force system must come from the battery, he added.

An experimental air-conditioned motor car has been built which incorporates the above requirements, Mr. Norris said. Distribution of air, filtered and cooled, is effected through a special ceiling grille; velocity of air is 12.5 ft. per min., constituting no perceptible draft; and each seat location is provided with a vent so passengers may adjust individual ventilation as desired, he said. The unit has been designed and built into the cowl space of the car and is entirely concealed behind the instrument board.

Between Sessions at Chicago

(Left to right)
R. S. Burnett
Fred Faulkner
C. A. Crowley

(In the foreground)
Grover Gilbert
Glenn Johnson
N. A. Jorgensen

R. B. May
H. R. Kemmerer
Harry Bryan

Harry O. Mathews
Ray Kiken

Photo-Chek Service

Retreading Growing Business

Retreading of tires is a growing business, declared Philip H. Smith, technical investigator, in a scheduled paper at the Thursday afternoon sesssion. Glenn W. Johnson was in the chair. Over 4,000,000 tires were retreaded during 1936, the speaker pointed out. Retreading and recapping as methods for increasing mileage on worn tires, are being practiced widely on the Pacific Coast and increasingly on the Atlantic seaboard and the central states, he stated.

Retreading, Mr. Smith declared, differs from recapping in that in the case of the former the old tread surface is buffed down to the fabric, the old cushion and break strips being removed; in recapping the rubber is not buffed down all the way to the fabric, nor are the shoulders removed. After outlining claims made for the two types of tire operations, Mr. Smith cited instances of savings effected by various fleet owners in the retreading of tires. Retreading, he stressed, is a specialized business requiring skill and proper equipment.

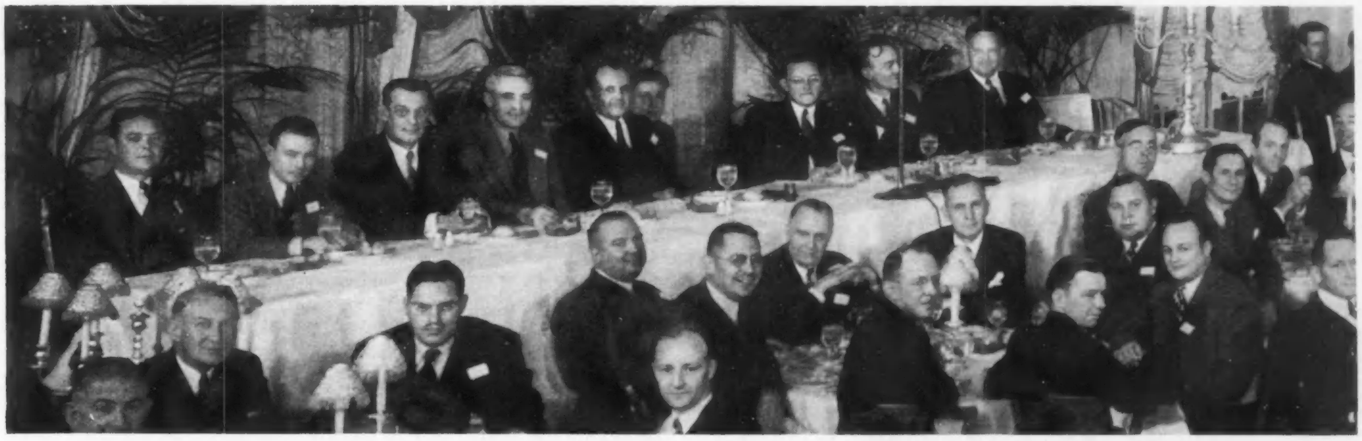
In a prepared discussion following Mr. Smith's paper, Howard L. Willett, Jr., and Carl H. Van Sinden, both of the Willett Co., reported experience of their firm in retreading as not convincing as to savings per mile. Further experience would be necessary in their opinion before a definite trend could be shown in favor of retreading. Marshall I. Lewis, Boston Store, Chicago, on the other hand, commented very favorably on his company's experience in the retreading of worn tires, enumerating instances where tires had been retreaded several times with good results.

At the Friday morning session, Stephen Johnson, Jr., who presided, introduced two speakers, H. O. Mathews, automotive engineer, Public Utilities Engineering & Service Corp., and J. A. Harvey, Pittsburgh Motor Coach Co. Mr. Mathews analyzing six types of 21-25 passenger buses now available for city operation, listed the following fundamentals as necessary to keep in mind when evaluating specific buses of this type: (1) passenger appeal; (2) riding comfort; (3) ease of ingress and egress; (4) probable life in miles; (5) changes in design during this life; (6) cost of chassis and body maintenance; (7) gasoline mileage; (8) tire costs per bus mile; (9) speed required to maintain schedule.

Life expectancy was reflected in depreciation rates varying from 1.68 to 1.865 cents per mile on an annual basis of 60,000 miles, or a variation of $108 per bus yearly. Because of probable changes in design, it seems inadvisable, said Mr. Mathews, to purchase a bus which must be maintained in service too long to amortize the original cost. Comparison of maintenance costs showed a range of from 1.2 cents per mile to 1.5 cents per mile. Similar differences were given for gasoline mileage and tire costs.

A proposed ideal bus was outlined by Mr. Mathews, one calculated to give the lowest operating cost per mile. Its major specifications were given as follows: weight, 8,000 lb., including tires and accessories; price, $4,000 at factory, less tires; engine size, 240 cu. in., approximately; brakes, air not over 40 lb. gross load per sq. in. area; tires, 7.50 x 18; first step, height 12 in., second 9 in.; location of

T. & M. Men Attend Chicago Meeting Dinner



Seated at the speakers' table, *from left:* Len Gilbert, general chairman of the meeting; Stephen Johnson, Jr., SAE vice-president representing the Truck, Bus and Railcar Activity; R. S. Burnett, manager, SAE Standards Department; John M. Orr, SAE vice-president representing the Transportation and Maintenance Activity; Harry Bryan, chairman, Chicago Section; Fred L. Faulkner, dinner chairman; C. A. Crowley and F. A. Faville, co-authors of paper presented at the after-dinner session.

motor, rear or under floor; wheelbase, 169 in. to 165 in.; turning radius 25 ft.; body width 96 in.; clutch 12 in.; load distribution 60 per cent rear, 40 per cent front with seats occupied; transverse seating arrangement; aisle width of 22 in.

Discussing improvements made in buses since 1930, Mr. Harvey declared that seven years ago the company's 30-passenger buses weighed 20,700 lb. each, while 1937 buses of same capacity weigh but 14,100 lb. or a saving in weight of 32 per cent. The gas consumption of the 1930 bus was 2.7 miles per gal. while the 1937 bus averages about 4.3 miles per gal., or a saving of 38 per cent.

Bus Maintenance Costs Cut

Maintenance costs have likewise been reduced through bus improvements, stated Mr. Harvey. Whereas in 1928 buses were greased and inspected every 1000 miles, today greasing and inspection are combined at 2500-mile intervals. Body and chassis are inspected rigidly at 5000 miles instead of every 2000 miles as in 1930. Reliability of service shows an equal improvement, he pointed out, revealing that buses were removed from service from all causes at the rate of 13.08 per 10,000 miles in 1928, while in 1936 this figure was reduced to 4.23 per 10,000 miles.

Depreciation rate has steadily been lowered, he said, stating that today the depreciation for a 30-passenger bus is 3 cents per mile instead of 7 cents per mile as in 1928. For the same type bus life-expectancy is eight years, or 300,000 miles today instead of only four years and 140,000 miles as in 1928, he added. Similarly for a 40-passenger bus, depreciation rate is now 3½ cents per mile instead of 10 cents, and expected life has been increased from four years or 120,000 miles in 1928 to eight years or 300,000 miles today, Mr. Harvey reported.

The speaker declared that with the greatly improved bus lighting systems, reflections are now a problem for the driver. Likewise continued improvement is desirable in reducing steering effort, especially on large urban models where driver fatigue is a problem, he concluded.

Mr. Mathews and Mr. Harvey's papers were discussed jointly from the floor, discussion being led by Mr. Scaife and Mr. Debbink.

Inspection trips through the plants of the Electro-Motive Corp., La Grange, Ill., and Universal Oil Products Co., Riverside, Ill., were a feature of the Friday afternoon program, the trips being under the general supervision of Mr. Willett, chairman on arrangements.

About Authors

(*Continued from page 11*)

automotive and petroleum industries have included membership on many of the Society's fuels and lubricants committees.

• Sidney Oldberg *has concentrated his efforts on the solution of automotive problems by electrical methods. His research work has led to the practical application of electronics and the development of vibration pickups which have revealed and evaluated forces heretofore immeasurable. He also has been responsible for the creation of various apparatus which have resulted in the increased accuracy and simplification of engine tests. He received his M.E. degree from Cornell University.*

• Frederic A. Seljé *turned from architectural to custom automobile-body design, eighteen years ago, and became active in both passenger and commercial car fields. He recognized the necessity for lighter commercial vehicles, and being familiar with the weight saving and structural advantages of duralumin, pioneered its use in the construction of buses, vans, tank trucks, dump trucks and armored cars. In 1926 his work attracted the attention of Walter P. Chrysler, and Mr. Seljé joined his company. After a period of production and custom body design and engineering, he developed the Chrysler line of Fargo Buses; the first 30-passenger buses to weigh less than 15,000 lb. Mr. Seljé helped design the Chrysler Exhibit at the Chicago Century of Progress Exposition in 1933. In July, 1935, he was appointed director of interior art and body design for Chrysler.*

• Charles Fayette Taylor *was in charge of U. S. Navy aeronautical engine laboratory during the war. In 1919 he resigned from active service with the rank of lieutenant in the Naval Reserve Force, and was appointed engineer in charge of power-plant laboratory, engineering division, U.S. Air Service at McCook Field. From 1923 to 1926 he was with the Wright Aeronautical Corp. in charge of engine design and development. In the latter year he joined the faculty of the Massachusetts Institute of Technology.*

• E. S. Taylor *received the Reed Award in 1937 for the invention of the dynamic damper which solved the problem of torsional vibration in radial aircraft engines. Many of his papers on different phases of the internal-combustion engine have been published in the SAE Journal. In addition to his duties as associate professor of aeronautics, in charge of the Sloan Automotive Engine Laboratory, at Massachusetts Institute of Technology, Professor Taylor is retained as a consultant by the Wright Aeronautical Corp.*

• Gilbert Way *has been a member of the Chrysler Engineering Staff for the past 11 years, having received his training at the University of Michigan. His work has been directed toward the utilization of fuels in motor cars and its attendant problems. In this connection he was active at the Cooperative Fuel Research Committee road tests made at Uniontown, Pa., in 1932 and 1934, and has since served on C.F.R. Road-Test Procedure Committees.*

• W. A. Witham *has had considerable experience in the specialized field of his paper. At present he is gear development engineer for the Gleason Works, engaged primarily in the development of hypoid gears for automotive rear-axle drives. He formerly was associated with the Studebaker Corp. in its research laboratories and, as a research engineer, with the Bound Brook Bearing Co. Mr. Witham received his engineering degree from Massachusetts Institute of Technology.*

• Austin M. Wolf, *in addition to carrying on a general consulting practice, is the man upon whom New York State relies as automotive consultant and director of standards. His yearly review of passenger car design trends in the SAE Journal has become one of the important technical events to which the industry looks forward. He has written extensively on automotive subjects for various publications.*

What

Foreign Technical Writers Are Saying

AIRCRAFT

Sur les Courbes Enveloppes des Familles d'Hélices Propulsives

By Albert Toussaint. Published in *La Technique Aéronautique,* 2nd quarter, 1937, p. 100. [A-1]

In this study the author, director of the Saint-Cyr Aeronautic Institute, presents the developments contributed by him to the method of calculating optimum propellers, since the session on this subject at the International Technical Meeting for Aeronautics, Nov. 23-27, 1936. These developments relate to the calculation of efficiency curves and of coefficients of traction and of circulation for "optimum" and "optimorum" families of propellers. A brief review of the fundamentals of the method is presented and then an example of its application, including the improvements made.

Untersuchungen über Einstufige Axialgebläse

By P. Ruden. Published in *Luftfahrt-Forschung,* July 20, 1937, p. 325. [A-1]

A report is made of the blower investigation carried out by the author at the Aerodynamic Research Institute at Göttingen in the course of the preliminary research in the development of the new Göttingen wind tunnel.

A blower rotor wheel was designed which has very high efficiency at its designed operating point, which is at moderate throttle, and which also permits of extreme throttling. To determine suitable operating factors, the author carried out an extensive theoretical investigation. In this, it was necessary to deviate from the usual assumption of vanishing radial speed. Through the introduction of diagrams, the calculations were considerably facilitated. The theoretical investigation is reported in the present article; the tests carried out at Göttingen are to be covered in a second part to be published later.

Application de la Balance Aérodynamique de Chalais-Meudon a l'Étude d'une Aile en Attaque Oblique

By M. P. Rebuffet. Published in *La Technique Aéronautique,* 2nd quarter, 1937, p. 118. [A-1]

A report is made of the study of a wing, under varied conditions of oblique angle of attack, made by means of the six-component aerodynamic balance in the Chalais-Meudon wind tunnel. A special mounting here described was provided to maintain the wing at the various angles of attack.

The conclusion drawn is that the aerodynamic balance is well adapted to the tests at oblique attack. The use of a rigid frame possessing certain degrees of liberty permitted the parameters to be easily varied. Furthermore the fact that lift, drag and drift could be simultaneously and automatically measured shortened considerably the time required for the investigation.

The Hague Show

Published in *Flight,* August 5, 1937, p. 139. [A-3]

Holland's own products formed the backbone of the Air Show staged this summer in the new "Houtrust" exhibition hall at The Hague. Great Britain made comparatively few offerings—though all were prominent in their peculiar fields—Germany has weighed in with her usual collective contribution, but France, Italy, and the rest were quite out of the picture.

The chief interest of the show was said to be the opportunity for ascertaining the state of the Dutch aircraft industry and of studying some of

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

the many ingenious instruments and accessories lately evolved on the Continent. These are briefly described.

Zur Theoretischen Behandlung des Gegenseitigen Einflusses von Tragflügel und Rumpf

By F. Vandrey. Published in *Luftfahrt-Forschung,* July 20, 1937, p. 347. [A-4]

Two methods are available for the theoretical treatment of the opposing effects of fuselage and wings. The first is to consider the entire group as a wing system, a method which does not give completely accurate results if the fuselage length is relatively great as compared with wing chord. A second method is to calculate the potential flow about the fuselage in the field of a parallel flow and an eddy. Lennertz, who used this method, confined himself to the ideal case of a fuselage in the shape of a sphere or an infinitely long cylinder.

The object of the present work is to extend the results obtained by Lennertz to general fuselage forms, and to assume also the case of a fuselage whose axis is inclined to the airflow. The calculations carried through refer to a semi-high wing monoplane. The fuselage is assumed to be a rotating body, symmetrical about its axis of rotation, with wings of infinite width and constant circulation traversing it at its thickest section. The lift distribution along the fuselage at axial and inclined airflow and the effect of the fuselage on the downwash on the controls are calculated. For the case of a spherical fuselage, the lift distribution along the wings is also calculated. The loss in lift with a definite span is estimated.

For a spherical fuselage, with infinitely wide wings, an increase in wing lift, offset by an equal decrease in fuselage lift is found. In the case of a long fuselage, the downwash on the controls is very small. A change in the effective angle of attack of the wings because of the fuselage does not take place in longitudinal airflow, if the lifting current lies in a vertical symmetry plane of the fuselage. For definite wing span, a loss in total lift results as compared with a wing of similar span without fuselage.

Die Relative Sicherheit des Mehrmotorigen Flugzeugs

By J. Stüper. Published in *Luftfahrt-Forschung,* July 20, 1937, p. 363. [A-4]

An analysis is made of the relative security of multi-engine as compared with single-engine airplanes. The decrease in the probability of forced landings through the division of power among a number of engines is investigated. The gain in safety of a multi-engine airplane because of the possibility of flying after an engine failure is evaluated. The effect of the higher loading on the engines remaining in operation is considered.

The twin-engine airplane is said to be from two to three times as safe as the three-engine airplane, according to the loading and the type of engine. The prediction is made that in the near future many airplane types using single engines will be converted to twin-engine craft. For the larger aircraft, four engines are thought to be the solution to be adopted.

CHASSIS PARTS

Frame Design

By D. Williams. Published in *The Automobile Engineer,* August, 1937, p. 295. [C-1]

In view of the popularity of the cruciform type of frame bracing and the box type of cross-section, the author has undertaken to analyze the relative advantages of these forms of construction as compared with the older type of frame consisting of parallel channel-section side-members "braced" by a few cross-members of similar section. A further analysis of the newer form of structure, designed to show the relative merits of the cruciform bracing and the box-section as contributors toward that stiffness which enables a frame to resist distortion out of its own plane, is included.

Der Kraftschluss zwischen Rad und Fahrbahn

By P. Koessler and H. Klaue. Published in *Automobiltechnische Zeitschrift,* May 10, 1937, p. 224. [C-1]

A review and interpretation of previous publications dealing with the inter-action of forces between the wheel and the road is here given. The objective is the development of more effective and reliable braking commensurate with the higher speeds predicted for the German automobile express highways.

The term "coefficient of friction" is rejected by the author, as he demonstrates that the actual force between the wheel and road in current racing cars is greater than any frictional value so far measured. He concludes that some other factor besides friction enters in the propulsive and braking effort, and so uses the expression, inter-action of forces.

A summary is given of the results attained by various experimenters measuring the forces between wheel and road by any one of four methods, braking, towing, direct determination and deceleration. The difference in the results attained indicates that certain influences are at work which have not been taken into consideration. Of these contributing factors, the street, the tires, wheel loading, vehicle speed, tire vibration and slip, the last named has been least investigated. Slip is defined as the difference between the peripheral speed of the wheel and the forward speed of the vehicle, and two types of slip are distinguished, that due to the deformation of the tire, and actual sliding of the tire relative to the road. In braking the tire deformation takes the form of stretching, and in forward propulsion, contraction. The inter-action of force between wheel and road is said to be directly dependent on the type and extent of slip, so that previous measurements neglecting this factor are unreliable. Investigations should be made to arrive at significant values for these forces, as related to friction, slip and vehicle speed. Only when the conditions are known under which the most favorable reaction of forces takes place, can the most effective brakes be designed. How tire design and material affect tire deformation is also discussed.

ENGINES

Some Experiments on Combustion in Oil Engines

By E. Glaister. Published in *Engineering,* Aug. 6, 1937, p. 139, and Aug. 20, 1937, p. 195. [E-1]

Mr. Glaister points out that the fuel requirements of the compression-ignition engine and the gasoline engine appear to be almost exactly opposed in regard to the ease with which the fuel can be ignited, and its subsequent rate of burning. The compression-ignition engine requires a fuel which, as a result of its readiness to ignite, reduces the delay period, and therefore the resulting knock, to a minimum. Such a fuel, in consequence of its tendency to detonate, will be almost useless in a gasoline engine. A general correlation between delay angle and H.U.C.R. might therefore be expected and has in fact been demonstrated. Boerlage, expressing the delay angle as the corresponding cetene number, has shown that fair correlation exists between this and the octane number over a wide range.

The question, therefore, is whether the correlation of delay angle and H.U.C.R. is independent of the nature of the fuel, so that any two fuels which give identical delay angles in the same compression-ignition engine must necessarily give the same H.U.C.R. in a gasoline engine. To explore the possible correlation over as wide a range as possible fuel mixtures were prepared which would exploit the full range of H.U.C.R. measurement available on the Ricardo engine. The results are shown in families of curves. The author concludes that within the small limit of experimental error involved, and for the fuels tested, the H.U.C.R. and the delay angle are equally affected by variations in ignition quality.

Additional tests were made to determine the effects of jacket temperature, and the effects of ignition quality.

The following conclusions were reached:

(a) When the ignition quality of the same fuel is varied by naphthenic and aromatic additions, respectively, good correlation is found to exist between the delay period and the H.U.C.R., and this correlation is the same for both groups of mixtures.

(b) The effect of variation in jacket temperature on the delay period and the uncontrolled pressure rise is appreciable, indicating the necessity for constant temperature conditions when

comparing the delay periods of different fuels, and the beneficial effects of a high jacket temperature on the smoothness of running.

(c) The effect of ignition quality on the delay and uncontrolled pressure rise was examined by adding amyl nitrite as an accelerator. It was found that when the slope and magnitude of the pressure rise are plotted against the delay, the same correlation holds whether the delay is varied by the ignition quality or jacket temperature, showing the delay and uncontrolled combustion to be equally affected by any factor which accelerates combustion, and supporting the adoption of the delay period as a criterion of fuel quality.

(d) The influence of ignition quality on the uncontrolled pressure rise is analyzed and shown to be normally obscured by the simultaneous variation in the delay. By eliminating delay variation the true effect of ignition quality alone is isolated, and shown to be exactly the reverse of its apparent effect when delay variation occurs simultaneously. It is shown that in the former case the slope and magnitude of the uncontrolled pressure rise are very nearly proportional over a wide range of ignition quality.

Der Einfluss des Schubstangenverhältnisses auf die Bewegungsvorgänge beim Kurbeltrieb

By Werner Vogel. Published in *Automobiltechnische Zeitschrift,* July 10, 1937, p. 336. [E-1]

Recent automotive and aircraft engine developments has been characterized by a decrease in connecting rod length in relation to crank radius, resulting in an increase in crank radius to rod length ratio of from 0.222 to 0.232 for motor-truck engines, 0.238 to 0.278 for passenger-car engines and 0.278 to 0.313 for aircraft engines, as compared with about 0.2 for steam engines and pumps.

To investigate the effect of this change in ratio on the movements of the connecting rod and the methods commonly used for calculating them is the object of this treatise. This is thought to be especially necessary in the case of acceleration, since the acceleration parabola as used in steam engine calculations is only an approximation, in which errors for a low crank radius to rod length ratio are negligible, but, for a high ratio, considerable. A systematic analysis is made to determine the influence of the ration on connecting rod movement and on the errors involved in the approximations, especially the actual behavior at peak speed and acceleration. Graphs incorporating the findings of the analysis offer a simpler substitute for the more involved formulas developed and show the extent of errors resulting from use of the approximations.

Berechnung und Entwurf von Schraubenlüftern für Kraftfahrzeuge

By Ernst M. Drucker. Published in *Automobiltechnische Zeitschrift,* July 25, 1937, p. 358. [E-1]

In this second report on the automotive cooling fan investigation being carried out at the machine laboratory of the engineering college at Vienna, calculations are made of fan strength, the relation between radiator and fan, the choice of radiator and fan dimensions, and of fan speed. The investigation is still in progress, and further reports will be made.

A Survey of the Development of the Automobile Radiator

By John Coltman. Printed by Whitehead Brothers, Ltd., Wolverhampton, England. 75 pp., illustrated. [E-3]

This survey of the development of the automobile radiator and its application to aircraft, rail motors, industrial uses, air heaters, oil coolers, etc., was presented as a paper before the Midland Branch of the Institution of Mechanical Engineers on November 19th, 1936, and has now been put into book form.

The author points out that he has compiled the paper with two objects in view: (a) to make available for those interested a clear account of the various species of the light high-efficiency liquid to air heat-interchanger, and to show the modifications introduced to suit the varying conditions of services; and (b) to outline simply the actual conditions of operation and to show their effect on performance.

A short bibliography is included.

Behandlung, Pflege, Prüfung und Einstellung von Kraftstoffeinspritzpumpen und Kraftstoffeinspritzventilen für Fahrzeugdieselmotoren in Praktischer Beleuchtung

By Heinz Fiebelkorn. Published in *Automobiltechnische Zeitschrift,* June 10, 1937, p. 276. [E-4]

In this practical treatise on the operation, maintenance, testing and adjustment of fuel injection pumps and valves for automotive Diesel engines, general design principles and operating difficulties are first discussed, and then the Bosch, Deutz and Deckel systems described in detail.

MATERIAL

Piston Rings and Cylinder Liners

By G. Williams. Published in *The Automobile Engineer,* August, 1937, p. 299. [G-1]

The author contends that although piston rings and cylinder liners are now made of alloys that did not exist commercially fifteen years ago,

the methods used for testing these materials have remained unchanged. Old methods are reviewed and new ones suggested under the headings: tensile testing, elasticity, permanent set, toughness, piston ring proportions, distortion of rings, and balanced physical properties. The article will be continued.

The Effect of Discontinuities and Surface Conditions on Failure Under Repeated Stress

By F. C. Lea. Published in *Engineering,* July 23, 1937, p. 87; Aug. 6, 1937, p. 140. [G-1]

The author reviews recent literature on this subject and describes his arrangement for carrying out fatigue tests under corrosion conditions. Preliminary tests were carried out on four steels, the compositions of which are given, together with a table showing the heat treatment and physical properties under ordinary laboratory conditions.

Other tests included a manganese steel tested in the Wohler machine, in air, and wetted with distilled water and synthetic sea water; a test of 0.84 per cent carbon steel with collars clamped on and turned on in air and distilled water and high carbon steels. Studies of the effect of case-hardening the surface and vee-grooves and nickel-plating on the range of repetition stress were made.

The Constitution of Tin-Rich Antimony-Cadmium-Tin Alloys

By D. Hanson and W. T. Pell-Walpole. [G-1]

A Study of the Deformation of the Macrostructure of Some Two-Phase Alloys by Cold-Rolling

By Hermann Unckel.

The Methods of Testing Zinc Coatings

By L. Kenworthy.

The Mechanical Properties of Some Metals and Alloys Broken at Ultra High Speeds

By D. W. Ginns.

A New Intermediate Phase in the Aluminum-Copper System

By A. G. Dowson.

The Constitution of the Alloys of Silver, Tin and Mercury

By Marie L. V. Gayler.

These papers have appeared in preprint form and will be published in permanent form in the *Journal of the Institute of Metals,* Vol. LXI, 1937, with the exception of the last on the list. which will appear in Vol. LX.

Einiges von der Entwicklung, der Konstruktion und den Betrieb von Leichtmetallagern

By H. Wiechell. Published in *Automobiltechnische Zeitschrift,* May 10, 1937, p. 235. [G-1]

In seeking a bearing metal more durable than babbitt for the high loads and temperature of aircraft-engine service, lead-bronze and cadmium were tried and rejected. Aluminum, because of its high melting point, bearing qualities, and low weight was next favorably considered. Two types of aluminum alloy that had previously given good service in other engine parts were investigated, copper and silicon alloys. Both alloys had the structure requisite for bearing metals, hard bearing crystals in a softer mass, but this structure was apparently destroyed by the machining with the lathe or scraper, and the alloys did not give favorable results as bearing metal. Various alloys and methods of working were then tried until a metal structure with acceptable machining and bearing qualities was developed.

The new alloy so developed was then subjected to laboratory tests by the Junkers company. Its smoothness, hardness, strength and wear resistance were determined, the last named by an apparatus designed by the company. The Junkers machine for testing bearings, here described, was also used in investigating the new alloy, and the results obtained given. The practical significance of the various tests is discussed.

In actual engine use bearings of the new alloy showed a tendency to seize, often after 50 or more hours of satisfactory service. Investigation revealed that this seizing was due to deformation attributable to the expansion of the metal at high temperature and to crankcase deformation. Various expedients were then tried in the construction of the bearing shell, in the effort to hinder the deformation of the bearing through temperature effects. Through these means the bearing was made sufficiently resistant to deformation for light but not for heavy duty. Other means for minimizing seizing were to increase clearance and perfect lubrication. With these precautions, the bearings are being used where given limitations of temperature and load are not exceeded. Two types of alloy, a hard and a soft, have been developed.

Wider utilization of aluminum bearings will probably necessitate the provision of a bronze or steel supporting shell. The field for lead-bronze and magnesium bearings is also indicated, the advice given that various types of metal must be used to fill differing service requirements, and that where aluminum is used the adaptability of the operating conditions to its limitations must be carefully investigated.

Die Nickelfreien Legierten Baustähle für den Kraftfahrbau

By E. Hain. Published in *Automobiltechnische Zeitschrift,* June 25, 1937, p. 299. [G-1]

Although economic conditions forced the substitution of nickel-free for nickel-alloy steels, the nickel-free steels are said to have justified their usage on the grounds of freedom from

impurities, evenness of structure and strength. Lists are given of 9 standardized chrome and chrome molybdenum steels and the nickel steels they replace; the commercial designations for these substitute steels of 11 firms producing them; 20 non-standardized nickel-free case hardening, 55 tempered, and 27 special oil-hardened, nitrided or rust proof steels together with their physical characteristics and heat treatment, and about 60 automotive parts and the nickel-free steels suitable for their construction.

MOTOR-TRUCK

Fortschritte im Anhängerbau

By Fritz Wittekind. Published in *Automobiltechnische Zeitschrift*, May 25, 1937, p. 245. [K-1]

That trailers for goods carrying are assuming an increasing importance in Germany is indicated by the growth in production from 6000 in 1933 to 27,000 in 1936. Standardization, concentration on types and improved design testify to their technical development.

Among the special design features noted are: electrically welded frames; rigid axles with tapered roller bearings; the introduction of independent wheel suspension; improved springing, specifically the use of a system in which the spring is progressively and proportionately less stressed as the load on it is increased; a dual wheel with a double hub permitting the two wheels to revolve independently of each other; three-axle trailers with a capacity of 12 tons; a four-axle trailer with a capacity of 15 tons; a cross-country trailer, and single-axle passenger trailers. These design features are illustrated in descriptions of many German makes of trailer.

PASSENGER CAR

Der Auto-Union-Rennwagen im Europäischen Rennsport

Published in *Automobiltechnische Zeitschrift*, July 10, 1937, p. 329. [L-1]

Among the author's general comments on the regulations governing European racing-car design is that the maximum weight restriction in force up through this year resulted in a weight per horsepower of about 5.4 lb., less than 1/10 that of a 50 hp. passenger-car. The 1938 rules adopt this year's maximum as the minimum weight, which will increase the weight per horsepower to 8.3 lb. for large cars, and almost twice that for small cars. A decrease in speed and the restoration of competition between large and small cars are the results predicted. The former have been at a disadvantage, since their greater power is effective only at higher speeds than can be attained on any European race course.

In the detailed description of the Auto-Union's racing car, comments made are that few fundamental changes have been made from 1934 to 1937, that the most important of these have been in body design, that its maximum speed has increased from 175 m.p.h. in 1934 to 240 m.p.h. in 1937, and that the location of the fuel tank in the center of the car results in undisturbed proportionate weight distribution during operation. A graph of relative weight distributions of passenger and racing cars shows that the large items for the former are body and useful load, and for the latter, engine and fuel. Emphasis is laid on tire wear and the price of speed is exemplified by the increase in power from 140 to 370 hp. and a decrease in tire wear of from 375 to 140 miles with an increase in average speed of from 75 to 82.5 m.p.h.

Applications Received

(Continued from page 17)

Enoch, Otto, research engineer, Ethyl Gasoline Corp., Research Laboratories, Detroit, Mich.

Fay, Byron A., vice-president, The Electric Auto-Lite Co., Toledo, O.

Gillan, Paul L., sales engineer, The Pemold Co., Cleveland, O.

Hall, Archibald M., president, Hall-Aluminum Aircraft Corp., Bristol, Pa.

Hammond, Dean Burt, vice-president and general manager, Stearman-Hammond Aircraft Corp., South San Francisco, Calif.

Hanscom, Russell Coldwell, motor check engineer, Associated Oil Co., Los Angeles, Calif.

Hart, Thomas James, 132 West 61st St., New York City.

Hetzel, Theodore Brinton, instructor, Haverford College, Haverford, Pa.

Higgins, F. D., commercial representative, Ford Motor Co., Pittsburgh, Pa.

Hottinger, Emil, engineer, Bearings Co. of America, Lancaster, Pa.

Hottner, John, foreman exp. engineering model shop, Fisher Body Corp., Detroit, Mich.

Hunt, George Elliott, Jr., test engineer, General Motors Proving Ground, Milford, Mich.

Kelly, Moore, Jr., salesman, Bound Brook Oilless Bearing Co., Detroit, Mich.

Kemmer, Capt. Paul H., Air Corps, U. S. Army, Wright Field, Dayton, O.

Ketcham, Robert Thompson, apprentice engineer, Caterpillar Tractor Co., Peoria, Ill.

Kibiger, Arthur Henry, body designer, Hudson Motor Car Co., Detroit, Mich.

Kurtz, L. G., Dept. Comm., Sanitation Department, New York City.

Lieber, Francis, inspector, Aero. Insurance Underwriters, New York City.

Luthe, Julius K., president, Perfex Corp., Milwaukee, Wis.

Lynch, Oscar P., assistant superintendent transportation, Humble Oil & Refining Co., Houston, Texas.

Lynn, Ted, president and treasurer, Aircraft Accessories Corp., Glendale, Calif.

Mann, Keeler George, sales engineer, General Motors Corp., New York City.

Marshall, Harry A., superintendent, body plant, Hudson Motor Car Co., Detroit, Mich.

May, Paul M., production engr., Cascade Engineering Co., Detroit, Mich.

Middlewood, Robert W., engineer, Stinson Aircraft Corp., Wayne, Mich.

Miller, Frederick A., warrant office, U. S. Army, Sault Ste. Marie, Mich.

Moody, Arthur M. G., instructor, University of Delaware, Newark, Del.

Morrison, Isadore, factory manager, Morrison Steel Products, Inc., Buffalo, N. Y.

Nikolich, Robert Philip, apprentice engineer, Caterpillar Tractor Co., Peoria, Ill.

Nulle, J. Howard, process inspector, Hyatt Roller Bearing Co., Harrison, N. J.

Nyquist, George M., Divco Twin Truck Co., Detroit, Mich.

Palmgren, Gunnar, chief engineer, SKF Industries, Inc., Philadelphia, Pa.

Patel, Nusli Sorabji, assistant to works manager, Messrs. Bombay Garage, Bombay, India.

Porter, Russell, draftsman, Glenn L. Martin Co., Baltimore, Md.

Sands, Thoburn Packard, Diesel engineer, Gulf Research & Development Co., Pittsburgh, Pa.

Saxton, William, engineer, Standard Steel Spring Co., Coraopolis, Pa.

Scherer, Ralph J., drafting, Fisher Body Corp., Detroit, Mich.

Seltje, Frederic A., director of art and body, Chrysler Corp., Detroit, Mich.

Shire, R. J., assistant, research department, D. Napier & Son, Ltd., London, England.

Shoens, Charles D., regional product rep., Chevrolet Motor Division, N. Tarrytown, N. Y.

Smith, Lawrence H., chief draftsman, Yellow Truck & Coach Mfg. Co., Pontiac, Mich.

Solian, Frank Eugene, research chemist, Commercial Solvents Corp., Terre Haute, Ind.

Todd, Harold A., president, general manager, Wisconsin Motor Corp., Milwaukee, Wis.

Wells, Leland E., assistant chief engineer, Willard Storage Battery Co., Cleveland, O.

Whitcamp, Henry Paul, civilian assistant, motor transportation, War Department, Chicago, Ill.

Willson, R. Duff, vice-president, Lights, Inc., Los Angeles, Calif.

Wilson, Ernest Emerson, technical assistant to director, General Motors Corp. Proving Ground, Milford, Mich.

Witchger, Eugene S., engineer, Eaton Mfg. Co., Detroit, Mich.

Wright, Claude Evelyn, engineer, Ontario Steel Products Co., Ltd., Gananoque, Ont., Canada.

SAE Papers in Digest

HERE are digests of papers presented at various meetings of the Society.

Some of these papers will be printed in full in the SAE JOURNAL.

Mimeographed copies of *all papers received* will be available, until current supplies are exhausted, at a cost of 25 cents per copy to members; and at 50 cents per copy to non-members, plus 2% sales tax on those delivered in New York City. Orders for mimeographed copies must be accompanied by remittance and should be addressed to Sessions Secretary, Society of Automotive Engineers, 29 West 39th St., New York.

SAE Regional Tractor Meeting Akron, Ohio – Sept. 15-17

Conditions Affecting Tire Life and Some Special Uses of Agricultural Tractor Tires – *J. G. Kreyer, Firestone Tire & Rubber Co.*

SINCE the introduction of pneumatic tires on farm tractors and implements, these manufacturers have been confronted with problems surrounding their use that require special attention and study. This paper points out some of the conditions needing more attention which will result in mutual benefit to both tire and tractor manufacturers and the consumer.

Of the conditions discussed the maximum wheel load heads the list as being first in importance. Other conditions taken up are insufficient tire size, overinflation, underinflation, and various soils with the proper types of tires and treads for each. Recommendations for the care of tires are given.

The Use of Liquid Weight in Farm Tractor Tires – *H. W. Delzell, The B. F. Goodrich Co.*

THE use of liquid in farm tractor tires is the outgrowth of a desire to obtain a cheap method of adding weight to rubber-tired tractors, as it appears definite that weight is a necessary function of traction.

In this paper the general procedure for filling the tires is recommended, as is the use of an anti-freeze liquid employing commercial flake calcium-chloride. Data are presented that show the amount and weight of the calcium-chloride solution held by the different sizes of tires. In addition to that of added weight, seven other advantages of liquid in tractor tires over air-filled tires with cast-iron weights are advanced. Claims are backed up by service-test results.

Steel, Implement, and Tractor Wheels for Rubber Tires – *John H. Ploehn, French & Hecht, Inc.*

IN this paper steel, implement and tractor wheels are classified, giving the design and construction details of each type, and the manufacturing methods employed. Reasons are given for variations in design and fabrication among the various types.

Development of steel, implement, and tractor wheels for rubber tires is traced back to the first successful steel implement wheel built in 1888. The important factor in making a wheel is specified as its economical manufacture, and the special equipment necessary to produce a wheel with the proper residual tension.

Farm Tractor and Implement Rim Problems – *J. G. Swain, Goodyear Tire and Rubber Co.*

BEFORE entering into a discussion of rims and rim mountings as applied to tractors and farm implements, this paper reviews the fundamentals of rim design. The paper is not intended to advance any new or radical ideas on rims, but rather to review the past and analyze the present state of the art, believing that it may be helpful in planning for the future.

It is at once evident that the rim is the foundation for the tire and must, therefore, conform in its general dimensions, and within definite limits, to the specifications established by the tire engineers. It is generally conceded that the fundamentals of sound and correct rim construction are four: (1) adequate strength, (2) simple design, (3) ease of operation, and (4) minimum weight.

Function and Operation of the Tire and Rim Association – *C. L. Wenzel, president, Tire and Rim Association, Inc.*

THE Tire and Rim Association is, in itself, a strictly technical body or group, interested solely in engineering standards – the guide of

automobile dealers, tire dealers, and garage men with respect to tires.

The history of the Association is reviewed stressing the value of the service that it renders in the standardization of tires, tubes, rims, and valve parts.

In conclusion the organization and operation of the Association are outlined, giving membership, inspection and standards set-up, committees, and a breakdown of their work.

The Traction of Pneumatic Tractor Tires – *R. P. Gaylord, Goodyear Tire and Rubber Co.*

THE cooperative tractor tire tests described in this paper were discussed originally at a meeting of the Society several years ago. The tractor engineers present at the discussion suggested to the tire engineers that there was need for a cooperative test program to determine the efficiency of the various tire sizes over a range of soil conditions.

Among the ten conclusions drawn from the comprehensive tests reported in this paper are that the most important factor affecting the coefficient of traction or tire thrust of rubber-tired tractors is the nature or surface of the operating soil; that, for a given soil, the most important factor is the weight that the tire carries; and that inflation pressure has a relatively small effect.

A New Method for Testing Tractor Tires – *A. W. Bull and M. K. Jessup, U. S. Rubber Products, Inc.*

THE purpose of this paper is to describe a photographic method for testing tractor tires and to indicate what can be done with it.

Essentially, the method consists in taking moving pictures of the instruments during runs in which the drawbar pull and travel ratios are progressively changing. The camera takes 16 exposures per sec. and makes it possible to follow all of the changes that occur during the run by careful examination of the photographs.

Advantages listed for the method include: greater speed and accuracy; amount of data permits the plotting of very complete curves; permanent, indelible records of the gage readings are obtained; and saving in expense because of reduced testing time.

Detroit Section Paper

April 26

The Supercharger – Its Progress and Prospects – *Robert A. Plumb, experimental engineer, Graham-Paige Motors Corp.*

A BRIEF résumé of supercharger developments from 1904 on, and some idea of the problems connected with their design and application are given in this paper. Figures are quoted to show how superchargers have increased payload capacity and improved performance on trans-oceanic and land-transport aircraft, and increased the speed of racing cars and speed boats.

Four major types of superchargers are mentioned: the plunger pump, the rotary compressor, the Roots, and the centrifugal type. Reasons are given to show why the centrifugal type has been the most popular in this country, and remarks are confined primarily to features of that particular design and correction of certain misconceptions concerning it.

So. California Section Papers

April 30

Aircraft-Engine Installations – *Ivar L. Shogran, Douglas Aircraft Co.*

THE installation of an engine in an airplane is still believed to be somewhat distant from an exact science, and this paper explains how installations are designed and developed largely from experience. Problems as a result of difficulties with exhaust tail-pipes, carburetor intake-air temperature, vibration, and oil-cooling are outlined with their solutions.

A four-engined airplane is described in which the engines furnish power only for propulsion, power for accessories being furnished by auxiliary engines.

The author feels that engine manufacturers soon should make a serious attempt toward designing and building an engine section consolidating many of the devices now installed as extra gadgets by the airplane manufacturer. He concludes with a plea for coordination among accessory manufacturers, engine manufacturers, airplane manufacturers, and operators.

Aircraft-Engine Maintenance – *E. O. Cooper, Pacific Airmotive Corp.*

A 50 per cent increase in the period between overhauls of transport aircraft engines is quoted in this paper to show the strides made by builders and maintenance men in the last six years.

Operation of the Airline Maintenance Committee is explained to illustrate the cooperation existing between the airlines and the Bureau of Air Commerce, and a brief outline of some of the major maintenance problems, together with their solutions, is presented, including those pertaining to burning of exhaust-valve seats, engine roughness at certain engine speeds, and master-rod bearing failures.

Unsolved maintenance problems are listed and maintenance procedure is outlined in the remainder of the paper.

Industry's Executives Gather at Biggest Annual Dinner

Photos by Nation-Wide News Service

"THE United States' sphere of influence lies in the western hemisphere – not in Europe nor the Orient." So Boake Carter, famed news commentator, declared at the 1937 SAE Annual Dinner, Oct. 28, in urging that this country should give prime consideration to the development of inter-American trade.

Some 1200 men of the industry, in New York for National Automobile Show Week, crowded the huge ballroom of the Commodore Hotel. W. J. Davidson of General Motors was toastmaster. SAE President Harry T. Woolson conducted a short business meeting during which Dr. H. C. Dickinson read the Nominating Committee's report and named candidates for 1938 SAE offices and Council membership. Presidential Nominee C. W. Spicer, when introduced by Mr. Woolson, thanked the Nominating Committee for the honor. Phil Spitalny and his All-Girl Orchestra provided the grand finale.

Linked together from Hudson Bay to Cape Horn, the United States and the countries of this hemisphere could be-

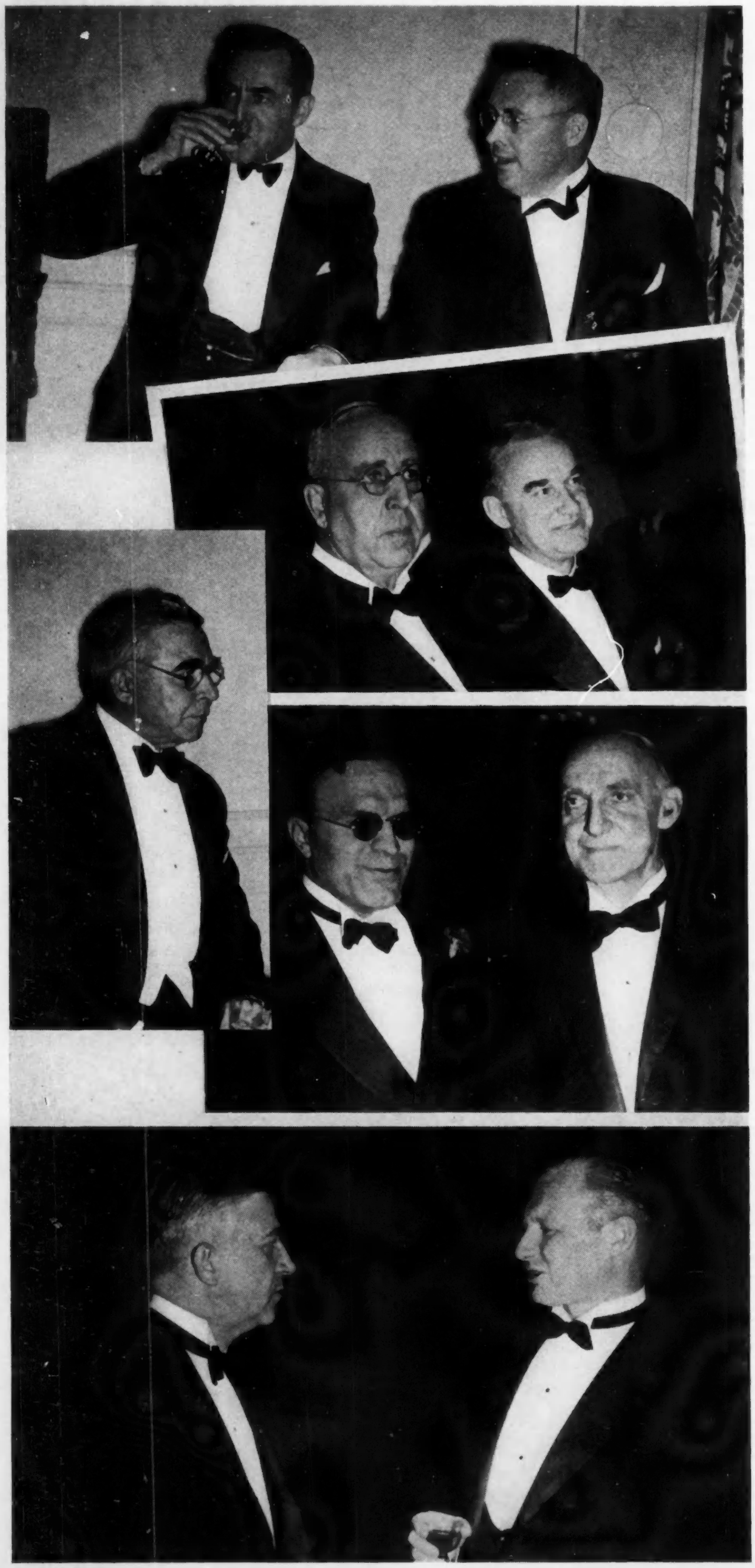
(Top to Bottom)

Speaker of the Evening Boake Carter, radio news commentator, and Toastmaster W. J. Davidson, General Motors Corp.

O. E. Hunt, vice-president, General Motors Corp., and C. W. Spicer, SAE Presidential Nominee and vice-president, Spicer Manufacturing Corp.

Paul G. Hoffman, president, Studebaker Corp. and director, Automobile Manufacturers Association, and SAE Past-President William B. Stout, president, Stout Engineering Laboratories

Guests of Honor Meet Before the Dinner



(Left to Right)

Irving B. Babcock, president and general manager, General Motors Truck & Coach of Yellow Truck & Coach Manufacturing Co., and Nicholas Dreystadt, general manager, Cadillac Motor Car Division of General Motors Corp.

P. W. Litchfield, president, The Goodyear Tire & Rubber Co., and D. L. Brown, president, United Aircraft Corp.

W. A. Irvin *(extreme left)*, president United States Steel Corp.

Ralph R. Teetor, past-president SAE and charge of engineering, Perfect Circle Co., and Dr. H. C. Dickinson, past-president SAE and Chief, Heat & Power Division, National Bureau of Standards.

Burt G. Close, president, Motor and Equipment Manufacturers Association, and Leo F. Hunderup, president, National Standard Parts Association.

All Photos by Nation-Wide News Service

come the most prosperous group of nations in material existence, Mr. Carter continued. The potential buying power of the Latin-American countries is 24 per cent in excess of the present output of every one of our industries working at full blast with full payrolls, he said, and backed up his statement with government statistics.

"To turn our attention to South America we must have the means of transporting goods to provide the kind of service that France, Germany and Britain are now supplying the South Americans – that means a decent merchant marine," the famed radio commentator declared. He charged that "American crates of goods are first to go into the holds of foreign ships and the last to come out. They are delayed, accidentally dropped, banged around, damaged. Time and time again goods have been returned to the United States from South America marked 'damaged in transit.'" He quotes South American business men as saying, "We like American goods best when we can get them . . . but we have to take inferior stuff because we know we can get better service on it."

David A. Wallace, president, Chrysler Sales Division, Chrysler Corp. (facing the camera), and Sayre M. Ramsdell, vice-president, Philco Radio & Television Corp.

At the Reception

America needs foreign trade with her mass production and surplus wealth, Mr. Carter stated, adding "but let that trade be developed in our own sphere of influence, in our own hemisphere, between Canada, Cuba, Mexico, Central and South America – all up and down the tens of thousands of miles of coastline of this enormous continent. We would have so much business to wrestle with and concern ourselves with that Europe and Asia would become incidental."

Concluding, Mr. Carter stated, "If we stick to our knitting in the North and South Americas, we might find not only enough commercialism to sustain our super-sophisticated economy, but a closer approach to the peace we have been looking for since the founding of our country."

(Top to Bottom)

F. L. Faulkner, nominee for SAE vice-president representing the Transportation and Maintenance Activity and manager, automotive department, Armour & Co., and Stephen Johnson, Jr., SAE vice-president representing the Truck, Bus & Railcar Activity and chief engineer, Bendix-Westinghouse Automotive Air Brake Co.

SAE President Harry T. Woolson, executive engineer, Chrysler Corp., with K. D. Smith, technical superintendent, tire division, B. F. Goodrich Co., and S. B. Robertson, president of the Goodrich company.

F. H. Russell, president, Manufacturers Aircraft Association, Inc., and J. T. Trippe, president, Pan-American Airways System.

News of the Society

Photo by Leslie Peat

T. L. Preble, vice-chairman of the Metropolitan Section was general chairman of the meeting

Engineers Jam Halls at Newark T. & M. Forum

• Metropolitan

OPENING to a capacity audience with a brilliant symposium of three papers on bus maintenance, the Metropolitan Section-Regional Transportation and Maintenance Meeting was held Nov. 9 and 10 at the Robert Treat Hotel, Newark, N. J. Seven technical papers were presented and such questions as: "Can a truck pull more than it can carry?"; "Are semi-trailers and six-wheelers fighting over the same bone?"; "How should trucks be rated?" stimulated more than a score of engineers and transportation experts into entering the discussions. T. L. Preble, Tide Water Associated Oil Co., and vice-chairman of the Metropolitan Section's T. & M. Activity, was general chairman. The Southern New England and the Philadelphia Sections cooperated.

With Carl Stocks, editor of *Bus Transportation,* in the chair, Chris Bockius and John Bassett, Raybestos Division, Raybestos-Manhattan, Inc.; J. H. Middlekamp, superintendent of equipment, Brooklyn Bus Corp., and William J. Cumming, general superintendent, Surface Transportation Corp., gave the principal papers at the opening session.

"Brakes – Can They Take It?" was the title of the paper by Messrs. Bockius and Bassett. It was a fundamental discussion of principles of braking, and an exposition of the development of new types of brake block materials required by greater gross weights and higher speeds of transportation vehicles of today. Manufacturers were challenged from the floor to so design brakes as to allow better cooling, and to provide proper equalization of all four brakes.

It was emphasized by the speakers that, although brake material development has progressed rapidly, no material yet devised would adequately dissipate heat in the process of braking with enough speed to remain dependable. The practice of covering wheels with steel sheets for the purpose of improving the appearance of the vehicle was roundly scored. It developed at the meeting that the practice of lubricating brakes when they became excessively hot had several vociferous adherents although the rebuttal attempted to show that this "cure" was a fallacy inasmuch as it defeated the very purpose of the brakes themselves.

That the problem of adequate braking is a fundamental one which will need closer attention of truck and bus manufacturers was shown by the authors who explained that energy required to be dissipated was on the order of the square of the speed – particularly in view of the fact that there appears to be no reason to believe that speeds will not be materially increased in the future.

Roy E. Berg, chief engineer, Johns-Manville Corp., pointed out that the brake material manufacturers must not be expected to solve the problem alone, but that energy-dissipation methods must be designed into the vehicle to aid in solving the problem of stopping heavy, fast-moving trucks and buses.

Mr. Middlekamp, whose paper "Prevention of Recurring Failures" was the second of the symposium, discussed in detail the part played by careful analysis of troubles in fleet operation. He pointed out that, with separate histories of each vehicle in a truck fleet recorded and cross-indexed, marked decreases in the cost of maintenance could be effected. The cost is more than justified, he said, because studies of failures in component parts reveal numerous facts which serve to guide in buying vehicles and equipment, as well as determining the relative ability of drivers to hold repair costs down. "This practice," he said, "has proved to be the most important single item in preventing failure of parts in our fleet."

Overloading buses and trucks beyond the rated capacity set by the vehicle manufacturer, inadequate and improper lubrication, failure to install parts either made by or approved by the vehicle manufacturer, and employing incompetent repair mechanics are cost-increasing factors in maintenance, Mr. Middlekamp said.

Bus drivers, he has found, usually abuse ve-

Meeting Rooms Were Packed

Courtesy Bus Transportation

Prominent truck and bus men can be recognized in this group attending the opening session of the Metropolitan Section-Regional Transportation and Maintenance Meeting, Newark, Nov. 9 & 10.

hicles only because they are forced to make excessively fast schedules. "Seldom have I ever found a driver who deliberately abuses his equipment," he said.

William J. Cumming, general superintendent, Surface Transportation Corp., New York, said that his company has kept a daily log of each vehicle. Some of them go back six years. Each year these are assembled for careful study, with the result that marked economies have been made in the operation of the bus system, he reported.

Six years ago tire failures represented about 40 per cent of the road delays of the company. As a result of this disclosure, the tire problem of today represents only 10 per cent of the delays, he said. The cards make it possible to check immediately causes of delays for the whole system.

Regular inspection periods, based on miles run, have been set for each vehicle, Mr. Cumming continued. Although he feels that it would be more to the point to set engine inspections on the basis of thousands of feet of piston travel, several devices tested to measure total piston travel have not been very successful to date.

Valves, he believes, will be eventually hard-faced with Stellite; the same material has been successfully used on wrist-pin bushings. Nitrided chrome-vanadium wrist-pins show remarkably long wearing qualities.

Much interest was aroused in Mr. Cumming's explanation of how worn crankshafts were ground down to allow a coating of molten high-carbon steel to be sprayed thereon. A coating of zinc is used to stop corrosion of water-pump housings.

"Although less complicated a mechanism than an engine, transmissions are the weak link in many of our bus designs," Mr. Cumming said. Narrow gear faces and the resulting high tooth pressure required to meet operating conditions, are the chief cause of the trouble, he believes.

The magnaflux method of crack detection has been adopted by the company, Mr. Cumming said, with a huge saving in operating costs. He urged the supplying of special tools to service modern buses.

The Tuesday evening session opened at 8 o'clock with Merrill C. Horine, sales promotion manager, Mack Mfg. Corp., as chairman. Billings Wilson, assistant general manager, The Port of New York Authority, described problems connected with the daily handling of thousands of trucks through the Holland Tunnel, under the Hudson River. Sketching the history of the Authority, a New York-New Jersey corporation set up to expedite the movement of traffic by ferries, bridges and vehicular tunnels, he showed that a decreasing percentage of the total is handled by the ferries.

Diesel-powered trucks and buses will be excluded from the first tube of the new Lincoln Tunnel under the Hudson, to open Dec. 22, because of the occasional blast of dense smoke emitted from the exhaust. This, although not poisonous as gasoline exhaust fumes, tends to confuse drivers by momentarily diminishing visibility, and constitutes a traffic hazard.

A specially designed wrecking truck, with steering wheel and an engine at each end, is being built by Mack Mfg. Corp., at the cost of $44,000, to handle towing emergencies in the new tunnel. Its towing capacity for vehicles on their own wheels, up a 4 per cent grade, is 70 tons, and its speed on level roads will be 20 m.p.h.

Declaring that the greatest cargo risk encountered in tunnel operation is gasoline tank trucks, Mr. Wilson said that celluloid, toxic acids, explosives, and other cargoes have also been excluded in the interest of safety to the public. He expressed considerable concern over the trend of larger gasoline tanks on interstate freight trucks which, if hit in a collision, would constitute a genuine hazard to everyone in the

(*Continued on page 26*)

Among Those Present at Newark

Top photos courtesy Bus Transportation

Top: **W. J. Sommers, F. K. Glynn and William J. Cumming**

Center: **A. J. Fraser, at the rostrum, and Carl Stocks**

Right: **Joseph A. Anglada**

Predicts Air Trips to Europe at Boat Rates

• So. New England

We will soon have regular trans-oceanic air service, Igor I. Sikorsky of United Aircraft Corp., told some 200 members and guests of the Southern New England Section at its Nov. 3 meeting. He also predicted that an air trip to Europe will, before long, cost no more than it does to go by ship today.

Discussing "Flying Clippers Today and Tomorrow," the speaker said we are now building skyliners of 25 to 50 tons, and we will be building them 50 to 100 tons for land travel and 100 tons for trans-oceanic travel within the next ten years. We could now build planes of 500 tons, but there is no call for them, and there may never be a demand for ships of that size, he added.

Airplane passengers, within the next few years, will have enlarged and more comfortable quarters, Mr. Sikorsky declared, picturing double-decked ships housing roomy dining salons and lounges large enough for dancing and motion picture presentations. Within 5 years, he said, trans-Atlantic flying time will be reduced from the present 20 hr. to 16 hr. The speaker believes that airplane speeds will not exceed 500 m.p.h., because at greater speeds

(*Continued on page 24*)

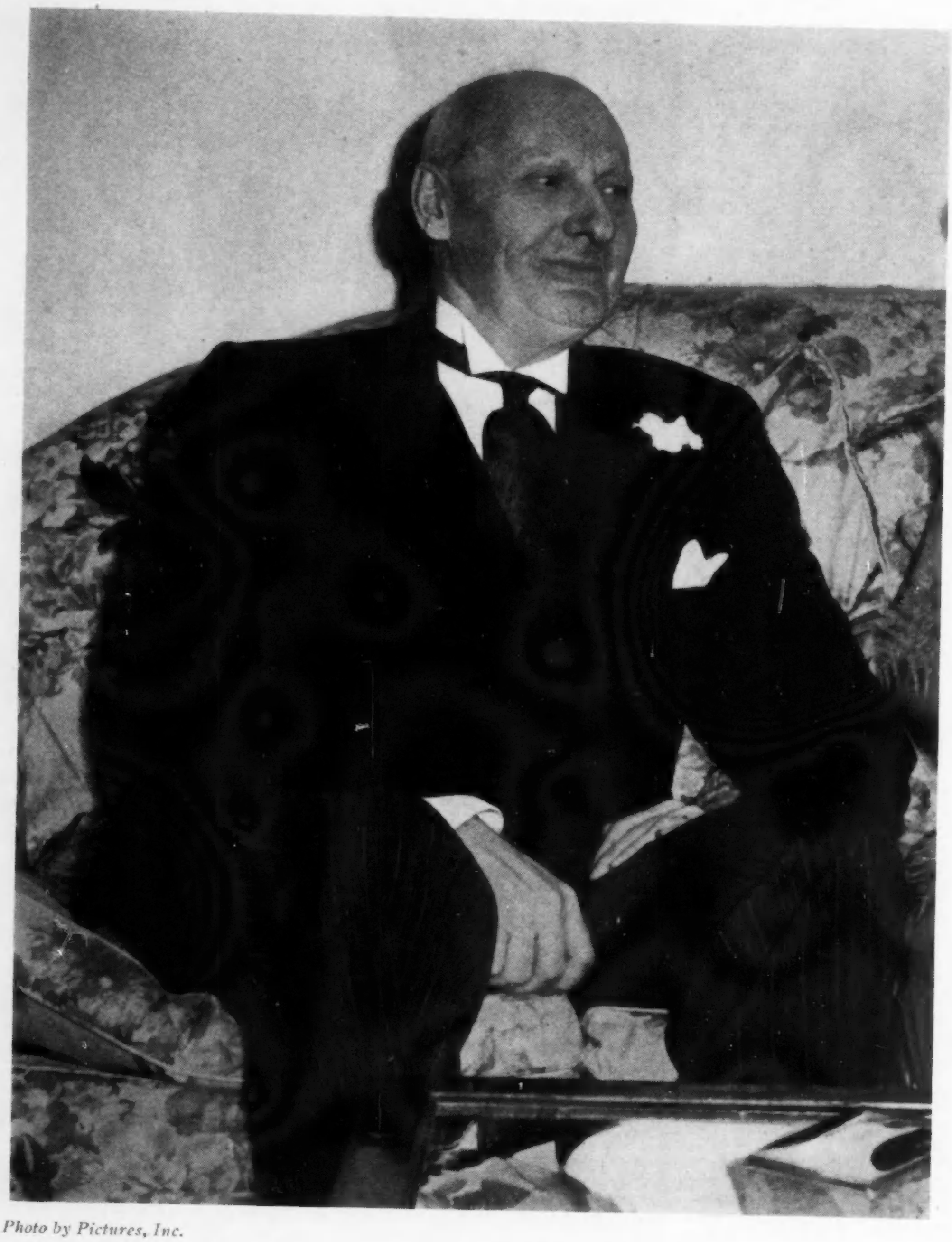


Photo by Pictures, Inc.

Howard Earle Coffin

Howard Earle Coffin

HOWARD EARLE COFFIN, president of the Society of Automotive Engineers in 1910, was discovered shot to death in the bedroom of his winter home at Sea Island, Ga., on Nov. 21. Although inactive in automotive affairs for some years, his chief activities being as chairman of the board of Southeastern Cottons, Inc., and of Young Management Corp., Mr. Coffin continued to maintain a serious interest in the SAE, in the early history of which he had played an extremely important part. He was a member of the Coker F. Clarkson Memorial Committee at the time of his death.

In 1907 Mr. Coffin became a member of the Society. Three years later he was elected its fourth president. The Society was then passing through a critical expansion period. It was in Mr. Coffin's administration that Coker F. Clarkson was secured as the first full-time secretary and general manager of the Society. In that year, too, the SAE took over standardization work begun by the Association of Licensed Automobile Manufacturers, marking the beginning of the far-reaching standardization work of the Society which has saved the industry millions of dollars.

These undertakings required more capital than the then Society of Automobile Engineers had available, and Mr. Coffin offered his personal check to advance the Society's work.

Mr. Coffin continued active in the Society long after serving as its president. He was chairman of the Nomenclature Division of the Standards Committee in 1911 and 1912, chairman of the Membership Committee in 1913 and 1914, chairman of the House Committee in 1920 and 1921, and chairman of the Constitution Committee in 1929. He was a member of other SAE committees during this period and he recently resumed his participation in SAE activities as a member of the Coker F. Clarkson Memorial Committee. He was elected a life member of the Society in 1935.

Mr. Coffin was a strong advocate of standardization and a pioneer in that movement which brought about tremendous increases in the production of low-priced cars.

With the development of aviation Mr. Coffin was one of the leaders in the movement which resulted in the amalgamation of the American Society of Aeronautical Engineers with the Society of Automobile Engineers, which then changed its name to the Society of Automotive Engineers, to embrace aeronautical engineering.

Mr. Coffin was a descendant of Tristram Coffin who settled on Nantucket Island in 1642. He was born 64 years ago in West Milton, Ohio, and received his earlier education in public schools of that community and of Ann Arbor, Mich. He entered the engineering department of the University of Michigan in 1893, but left before completing his course to enter the United States Postal Service. Returning to college in 1900, he resumed his studies, leaving again in 1902 to join the Olds Motor Co. This was his first connection with the automotive industry, although he had previously built a gasoline and a steam automobile of his own. For three years Mr. Coffin was chief of the Olds experimental department and for one year was chief engineer.

He left Olds to become the vice-president and chief engineer of the E. R. Thomas-Detroit Co., which later became the Chalmers-Detroit Motor Co. In 1910 he was appointed vice-president and consulting engineer of the Hudson Motor Car Co., which he had helped to found. He continued in that capacity until retiring from the automotive industry in 1930.

In 1916 Mr. Coffin was appointed chairman of the Committee on Industrial Relations by President Wilson. In this position he called together officials of the five leading engineering societies of the country and, with them, made an almost overnight census of the country's industrial resources which might be drafted in case of war.

When the Aircraft Production Board was formed Mr. Coffin was appointed its leader. He immediately called some of the nation's foremost automotive engineers together and with them designed the Liberty motor, a standardized American-made motor for American planes. During this period he also served on the Naval Consulting Board, organized by Josephus Daniels, then Secretary of the Navy.

After the War, Mr. Coffin became interested in commercial aviation. He was president of the National Air Transport, Inc., from 1925 until 1928, when he became chairman of the board. He held this office until his retirement in 1930.

Soon after withdrawing from the automotive and aviation industries Mr. Coffin became active in the development of Sea Island, Ga., an extensive real estate venture which developed this part of the Georgia coast into a well-known resort.

In 1932 he became interested in the textile industry and bought into the Hunter Manufacture and Commission Co., one of the largest textile selling organizations in the world. This he helped to liquidate and he became one of the founders and chairman of the board of Southeastern Cottons, Inc.

Mr. Coffin was vice-president and director of the Farm Chemurgic Council; a director of the National Association of Manufacturers and of the Merchants Association of New York; former president of the National Aeronautical Association of the United States, and a member of the American Society of Mechanical Engineers, the Detroit Engineering Society, the Engineers Club of New York, the Racquet and Congressional Country Clubs of Washington, the Sea Island Yacht Club, the Detroit Boat Club and the Rockwood Hall Country Club of Tarrytown, N. Y. He was also chairman of the board of the Sea Island Co., the Sulflow Corp., and a director of the Brunswick Pulp and Paper Co.

Mr. Coffin received his degree from the University of Michigan in 1911, as of the class of '03. He received the honorary degree of Doctor of Engineering in 1917. Mercer University conferred the honorary degree of Doctor of Laws upon him and the Georgia School of Technology that of Doctor of Science.

His wife, the former Miss Gladys Baker whom he married in June of this year, survives him. Mr. Coffin was previously married in 1907 to Miss Matilda V. Allen, who died in 1932.

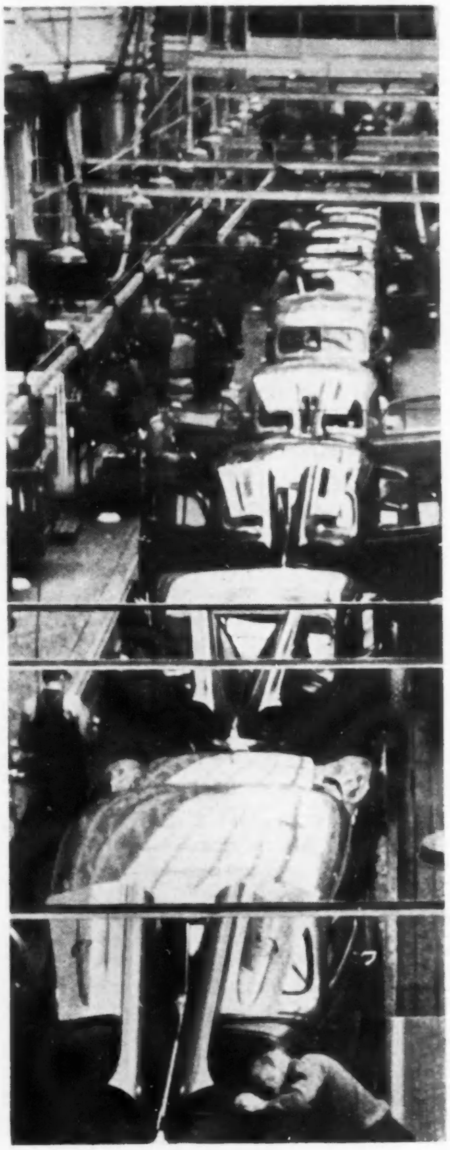
National

PRODUCTION MEETING

Dec. 8, 9 and 10

Flint, Mich. **Durant Hotel**

Sponsored by the SAE Production Activity
W. B. Hurley, *Vice-President*



PROGRAM

Wednesday, Dec. 8

9:30 A.M.

Registration at SAE Desk, Durant Hotel

2:00 P.M. Forgings and Castings

Leroy Cram, *Chairman*

Casting and Machining of Ford Cast Steel Pistons – W. F. Pioch, Ford Motor Co.

Precision Forging Practice – L. A. Danse, Cadillac Motor Car Co.

8:00 P.M. Welding

American Welding Society, Co-Sponsor

F. W. Cederleaf, *SAE Chairman*

Vaughan Re d, *AWS Chairman*

The Fundamentals of Welding – Dr. C. A. Adams, E. G. Budd Manufacturing Co.

Recent Developments in Resistance Welding – J. S. Williams, P. R. Mallory Co.

Thursday, Dec. 9

9:00 A.M. Plant Visit

Fisher Body Plant No. 1 (Buick)

2:00 P.M. Paints and Planning

V. P. Rumely, *Chairman*

The Finishing of Automotive Parts with Synthetic Resin Enamels – J. L. McCloud, Ford Motor Co.

Purchasing, Planning and Scheduling Parts for Building Multiple Model Automobiles – D. A. Wallace, Chrysler Corp.

8:00 P.M. Machining Problems

W. H. McCoy, *Chairman*

Do We Understand the Grinding Process – R. V. Hutchinson, Olds Motor Works

Peculiar Machining Problems of the Automatic Transmission – F. C. Pyper, Buick Motor Co.

Friday, Dec. 10

9:00 A.M. Plant Visit

Buick Plant No. 66 (transmissions)

2:00 P.M. Precision Parts

Joseph Geschelin, *Chairman*

Recent Developments in Spline and Gear Cutting and Finishing – R. B. Haynes, Spicer Manufacturing Corp.

The Economical Mass Production of Accurate Gears – C. H. Stanard, Buick Motor Co.

6:00 P.M. Production Dinner

C. A. Chayne, *Chairman*

Toastmaster – Michael A. Gorman, editor, Flint Journal

Speaker – Arnold Lenz, Chevrolet Motor Division, General Motors Corp.

Dinner Tickets—$2.00 Each
No Reserved Places

COMMITTEES

Plant Visits – John P. Heiss, Perry L. Tenney, Frank C. Pearson.

Entertainment – W. C. Haight, M. T. Kennedy, R. B. Schenck, D. W. Randolph, J. R. Emerson.

Dinner – C. J. Lauer, E. F. Bacon and J. E. Eshbaugh.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Oct. 15, 1937, and Nov. 15, 1937.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

ADAMS, PARKER J., JR. (A) service superintendent, Les Vogel Chevrolet Co., Market St. & Van Ness Ave., South, San Francisco, Calif. (mail) 790 – 22nd Ave.

BLACKWOOD, ROBERT RUTHERFORD (FM) rubber technologist, Dunlop Perdriau Rubber Co., Ltd., 108 Flinders St., Melbourne C 1, Victoria, Australia.

BUMBAUGH, FRANK T. (M) manager, bar & semi-finished division, Metallurgical Dept., Carnegie-Illinois Steel Corp., 661 Frick Bldg. Annex, Pittsburgh, Pa.

BURBANK, W. T. (J) draftsman, Fairbanks, Morse & Co., Three Rivers, Mich. (mail) 614 Pine St.

COLTMAN, JOHN LOUIS (FM) draftsman, Nasmyth, Wilson & Co., Ltd., Patricroft, Manchester, England. (mail) 7 Mirfield Dr., Monton, Eccles, Manchester, England.

CRANDALL, MORRIS N. (A) manager, Wabash Valley Service Co., Grayville, Ill. (mail) Grayville, Ill.

DICK, HAROLD G. (M) aeronautical engineer, Goodyear Zeppelin Corp., Akron, Ohio. (mail) Luftschiffbau Zeppelin, Friedrichshafen, a.B., Germany.

DUCKHAM, ALEXANDER (FM) governing director, chairman, A. Duckham & Co., Ltd.; Trinidad Central Oilfields, Ltd., 16 Cannon St., London E. C. 4, England. (mail) A. Duckham & Co., Laboratory, Holyport Road, Fulham, London, England.

ENRIGHT, EUGENE M. (A) district automotive inspector, Socony-Vacuum Oil Co., Inc., Schenectady, N. Y. (mail) 10 Eagle St.

FISHER, FRED D. (A) secretary, treasurer, Scientific Brake Service Laboratory, Inc., 3401 South Parkway, Chicago, Ill.

FOX, ALBERT H. (M) research engineer, Standard Oil Co. (Indiana), Whiting, Ind. (mail) 1915 Wespark Ave.

GADDA, CARLOS M. (FM) Naval Officer, Navy Department, Buenos Aires, Argentine, South America. (mail) Direccion General de Aviacion Naval, Esmeralda 750.

GLOWINSKI, ALBERT D. (J) engineer, Societe des Moteurs Gnome-Rhone, Paris, France. (mail) 41 Ave. du Marechal Lyantey.

GUNDRY, DAVID LEE (J) research assistant, White Motor Co., 842 East 79th St., Cleveland, Ohio. (mail) Quad Hall, 7500 Euclid Ave.

HANNING, JAMES R. (M) sales engineer, Canadian National Carbon Co., Ltd., 805 Davenport Road, Toronto, Ontario, Canada.

HERMSEN, B. A. (M) superintendent of transportation, Nebraska Power Co., 17th & Harney Sts., Omaha, Neb. (mail) 43rd & Leavenworth St.

HILTON, LOUIS MASSEY, LIEUT. (FM) director, Fairey Aviation Co., Ltd., Hayes, Middlesex, England.

HOBEIN, KINGSLAND (J) engine tester, Wright Aeronautical Corp., Paterson, N. J. (mail) 130 Edgemont Road, Upper Montclair, N. J.

HOOD, G. G. (A) vice-president, general manager, Ontario Steel Products Co., Ltd., Gananoque, Ontario, Canada.

HUDLASS, MAURICE (FM) consulting engineer, Royal Automobile Club, Pall Mall, London S.W. 1, England.

JONES, J. BYRON (J) instructor of engineering, Casey Jones School of Aeronautics, 534 Broad St., Newark, N. J.

KEIM, CHARLES J. (J) design engineer, Oil Well Supply Co., Dallas, Texas.

KRITSER, SHELBY MASTERSON (J) apprentice engineer, Pan-American Airways, Port Washington, L. I., N. Y.

MARCONI, FRED (A) owner, operator, Marconi Service Garage, R. R. 3, Victoria, British Columbia, Canada.

MCLEAN, JOHN ROY (A) sales manager, Exide Batteries of Canada, Ltd., 153 Dufferin St., Toronto, Ontario, Canada.

MOORE, FRED L. (M) staff engineer, Quality Bakers of America, 120 West 42nd St., New York City.

MORGANA, E. FRANK (M) test engineer, Wright Aeronautical Corp., Paterson, N. J.

SLEEPER, ARNOLD Z. (J) sales engineer, National Carbon Co., 230 North Michigan, Chicago, Ill. (mail) 5259 Balfour, Detroit, Mich.

TIGHE, WILLIAM ROLLINS (A) lubricating assistant, Standard Oil Co. of N. J., St. Paul & Franklin Sts., Baltimore, Md.

UHRICH, HAROLD R. (J) design engineer, Sensenich Brothers, Lititz, Pa.

WINSLOW, JAMES C. (J) draftsman, Boeing Airplane Co., Georgetown Station, Seattle, Wash. (mail) 1330 Boren Ave.

WOODWARD, GEO. H. (M) manager, 1455-65 Bush St., San Francisco, Calif.

Applications Received

The applications for membership received between Oct. 15, 1937, and Nov. 15, 1937, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

ALDRICH, JOHN G., JR., designer, Hudson Motor Car Co., Detroit, Mich.

ALLEN, THERON E., secretary, manager of contest board, American Automobile Association, Washington, D. C.

AUSTIN, DWIGHT E., engineer, Yellow Truck & Coach Co., Pontiac, Mich.

BALL, THOMAS, assistant engineer, Birmingham & Midland Motor Omnibus Co., Birmingham, Mich.

BEVAN, GUY T. M., chief engineer, Massey-Harris Co., Ltd., Toronto, Ont., Canada.

BIGLEY, HARRY A., JR., lubrication engineer, Gulf Research & Development Co., Pittsburgh, Pa.

BIRD, KENNETH L., inspector, production testing, Pratt & Whitney Aircraft Division, United Aircraft Corp., E. Hartford, Conn.

BOES, WALTER W., branch manager, Perfex Corp., Milwaukee, Wis.

CARTER, LEON T., engineer, General Electric Co., New York City.

CATTANEO, ALFRED G., research engineer, Shell Development Co., Emeryville, Calif.

COLNER, VICTOR, sales engineer, Joseph Weidenhoff, Inc., Chicago, Ill.

COVINGTON, THOMAS F., superintendent of maintenance, Davidson Transfer & Storage Co., Baltimore, Md.

CRICK, STEPHEN E., automotive engineer, Contest Board, American Automobile Association, Washington, D. C.

CROWELL, PRESTON, special representative, B. F. Goodrich Co., Akron, O.

DAVIS, MARVIN WILLIAM, sales engineer, Sheffield Gage Corp., Dayton, O.

DAY, ALFRED VINCENT, engine tester, Pratt & Whitney Aircraft, E. Hartford, Conn.

DEBOER, FRED L., draftsman, MacClatchie Mfg. Co. of California, Compton, Calif.

DETRIE, ARTHUR J., auto and combustion engineer, Standard Oil Co., Green Bay, Wis.

DICKERSON, CHARLES E. S., president, Miami-Dickerson Steel Co., Dayton, O.

DOUGLAS, LEON L., engineer, Seversky Aircraft Corp., Farmingdale, N. Y.

ECKSTROM, CLARENCE D., Lieutenant, U. S. Navy, Naval Air Station, Seattle, Wash.

ELMSLEY, C. M. R., 2nd Lieutenant, Royal Canadian Ordnance Corps, Kingston, Ont., Canada.

GAMMAGE, C. N., general manager, Hayes Steel Products, Ltd., Merritton, Ont., Canada.

GARDOTZKI, THEODORE J., plant and experimental engineer, Koster Specialty Mfg. Co., Inc., New York City.

GASKELL, GEORGE R., vice-president, Winters National Bank & Trust Co., Dayton, O.

GOGOL, LEW, body draftsman, The Murray Corp. of America, Detroit, Mich.

GOOCH, PETER WILLIAM, draftsman, de Havilland Aircraft of Canada, Toronto, Ont., Canada.

GRABOW, EDWARD OTTO, JR., planning department, Carrier Air Conditioning, Syracuse, N. Y.

HALL, HAROLD G., district representative, John Bean Mfg. Co., Lansing, Mich.

HAVEY, EARL M., body designer, Hudson Motor Co., Detroit, Mich.

IBSER, HENRY P., time study, Chrysler Corp., Detroit, Mich.

IRELAN, F. H., general manager, Delco Brake Division, General Motors, Dayton, O.

JAY, STEPHEN VINCENT, lubrication engineer, Humble Oil & Refining Co., Houston, Texas.

JORDAN, WILLIAM CONRAD, general manager, Steel Products Engineering Co., Springfield, O.

KAY, LESLIE, engineer, Perfect Circle Co., Ltd., Toronto, Ont., Canada.

KLEIN, J. H., JR., director of inspection and standards, Delco Brake Division of General Motors Corp., Dayton, O.

KNELL, HERBERT J., test observer, Wright Aeronautical Corp., Paterson, N. J.

KNIPPING, HERMANN, assistant sales manager, W. Ferd. Klingelnberg Soehne, Remscheid, Germany.

KURTZ, JOHN VICTOR, draftsman, engineering department, Ford Motor Co. of Canada, Ltd., Windsor, Ont., Canada.

LAUGHTER, DAVID ROBERT, sales manager, Cimatool Co., Dayton, O.

LAUGHTER, GEORGE D., sales engineer, Cimatool Co., Dayton, O.

LEASENFELD, CHARLES J., correspondent, C. J. Tagliabue Mfg. Co., Brooklyn, N. Y.

LEWIS, FRED O., superintendent of transportation, Dayton Power & Light Co., Dayton, O.

LINES, TEX S., detail draftsman, Hudson Motor Car Co., Detroit, Mich.

LOMBARDI, LORETO, draftsman, Glenn L. Martin Co., Baltimore, Md.

(Continued on page 30)

About SAE Members:

Walter O. Briggs, chairman, Briggs Manufacturing Co., recently presented a gift of athletic equipment to the Michigan State Normal College.

Charles R. Miller and *George A. Round,* Socony-Vacuum engineers, were on the program of Cleveland's fall clinic for gasoline station attendants held early last month.

R. E. Northway has been named mechanical research engineer, Saco & Lowell Shops, Biddeford, Maine. He was previously special machine and tool designer.

Sherman M. Fairchild, president of Fairchild Engine & Airplane Corp., has been named president of Fairchild Aircraft Corp.

Clinton Brettell has been named chairman of an engineering committee for the recently formed private carrier division of the American Trucking Association. He is organizing a committee which will be representative of the various private carrier groups. From 1927 until his recent resignation Mr. Brettell was superintendent of garages for R. H. Macy & Co., Inc., N. Y. He has been identified with automotive transportation and maintenance since 1914, supervising oil company, chain grocery, haulage and department store fleets. He has not yet announced his future plans.

Edward P. Warner has been added to the faculty of Norwich University, Northfield, Vt., as special lecturer on the development and future of air transportation.

Richard H. Valentine is secretary-treasurer of Van Alst Motors, Inc., car dealers in Astoria, N. Y.

William A. Heine, Jr., until recently research associate, National Bureau of Standards, Washington, has joined the staff of Tide Water Associated Oil Co., Bayonne, N. J., as automotive engineer.

Lee Oldfield
To Schwitzer-Cummins

Lee Oldfield has been appointed consulting engineer of the Schwitzer-Cummins Co., Indianapolis.

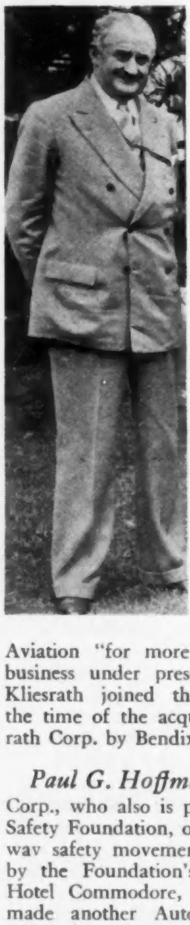
Herbert G. Winter has joined H. W. Shay & Associates, Highland Park, Mich.

N.B.M.A. Officers

The newly elected officers and directors of the National Battery Manufacturers Association include four SAE members. E. T. Foote, vice-president of Globe-Union, Inc., was elected second vice-president. Named to the board of directors were: F. C. Kroeger, general manager, Delco-Remy Corp.; S. W. Rolph, vice-president and general manager, Willard Storage Battery Co.; and B. F. Morris, vice-president, Thomas A. Edison, Inc.

George T. Chapman is machine development engineer with Eaton Manufacturing Co., Spring Division, Detroit. He joined that company early in October. Mr. Chapman was previously design engineer with Carborundum Co., Hutto Machine Division, also Detroit.

Victor W. Kliesrath, vice-president and director of Bendix Aviation Corp. and director of engineering of Bendix Products Corp., has been named general manager of the latter company. This announcement accompanied news of changes in the corporate structure of Bendix



V. W. Kliesrath
General Manager

Aviation "for more practical operation of its business under present day conditions." Mr. Kliesrath joined the Bendix organization at the time of the acquisition of the Bragg-Kliesrath Corp. by Bendix Aviation.

Paul G. Hoffman, president of Studebaker Corp., who also is president of the Automotive Safety Foundation, outlined the industry's highway safety movement at a luncheon sponsored by the Foundation's board of trustees at the Hotel Commodore, New York, Oct. 29. He made another Automobile-Show week safety talk before the Advertising Club of New York at luncheon, Oct. 27.

Mr. Hoffman has also been named a member of the jury which will judge entries in a national competition for the most suitable structural and architectural design for an elevated highway, sponsored by the American Institute of Steel Construction.

Howard Hill is student lubrication engineer with Shell Petroleum Corp., St. Louis, Mo.

Merton H. Blank has been promoted to chief engineer of the Hydraulic Coupling Division of the American Blower Corp., Detroit, with which he has been affiliated since the first of the year.

Gerthal French, formerly aviation department, Sinclair Refining Co., New York, has affiliated with the Richfield Oil Corp., Los Angeles, as manager of the lubricating sales department.

Dr. Miller McClintock, director, Bureau for Street Traffic Research, Harvard University, addressed the Engineering Society of Detroit at its Nov. 5 dinner meeting.

Dr. Paul H. Schweitzer, professor of engineering, Pennsylvania State College, has

P. H. Schweitzer
Lieutenant Commander

been appointed lieutenant commander, United States Naval Reserve.

Paul S. Lane, metallurgical engineer, American Hammered Piston Ring Division, Koppers Co., Pittsburgh, spoke on "Structure and Wear of Gray Cast Iron," before the Philadelphia Chapter of the American Foundrymen's Association, Nov. 12.

J. D. Armour, chief metallurgist, Union Drawn Steel Co., addressed the Saginaw, Mich., Section of the American Society for Metals, Nov. 16, on "The Free Machining Steels – Their Metallurgy and Machining Characteristics."

Norman G. Shidle, executive editor, SAE Journal, has been appointed to the executive board of the New York Business Paper Editors.

James Y. Scott, executive vice-president and general manager, Van Norman Machine Tool Co., Springfield, Mass., has been made a member of the executive committee of the Associated Industries of Massachusetts.

William B. Todd has resigned as vice-president in charge of sales and director of the Jones & Laughlin Steel Corp., Pittsburgh. He joined the company in 1922, at that time resigning as vice-president of Union Drawn Steel Co.

Alfred P. Sloan, Jr., chairman of the board, General Motors Corp., has accepted an invitation to address the Association of Life Insurance Presidents at its 31st annual convention, New York, Dec. 2 and 3.

William A. Irvin, president of the United States Steel Corp., will become vice-chairman of the corporation on April 5.

Louis R. Jones
With Hupp

Louis R. Jones has been made assistant engineer of the Hupp Motor Car Corp., Detroit, Mich. He was previously chief engineer of the Auburn Automobile Co., Connersville, Ind.

SAE Men on A.P.I. Program

Charles F. Kettering, vice-president and director of research, General Motors Corp., was the principal speaker at the 18th Annual Meeting of the American Petroleum Institute, Chicago, Nov. 8-12.

K. G. Mackenzie, The Texas Co., James B. Rather, Socony-Vacuum Oil Co., Inc., and Leo Huff, Pure Oil Co., respectively, presided at sessions devoted to Miscellaneous Topics, Isooctane and Truck Tanks. SAE members who presented papers include G. A. Hope and W. S. Mount, Socony-Vacuum Oil Co., Inc.; Gustav Egloff, Universal Oil Products Co.; S. D. Heron, Ethyl Gasoline Corp.; Neil MacCoull and K. L. Hollister, The Texas Co.

The papers presented by S. D. Heron on "100 Octane Number Fuels," and by Dr. Gustav Egloff, with J. C. Morrell, and E. F. Nelson, on "Aviation and Motor Fuels as Produced by Polymerization," were published in the Nov. 17 issue of *National Petroleum News*.

B. A. Ruhling is president and manager of the Midland Rubber Co., Cedar Rapids, Iowa. He was previously vice-president in charge of production and development, Rubber Industries, Inc., Keokuk, Iowa.

Harrison L. Hart has been named general sales manager, Wico Electric Co., Springfield, Mass. Before this advancement he was midwest district manager with headquarters in Chicago. He joined the Wico organization in 1913, immediately after leaving school.

Harrison L. Hart
Manages Sales

Eugene Herzfeld, who has been affiliated with the Combustion Engineering Co., New York, as mechanical engineer, has taken a similar position with the Detroit Edison Co., Detroit.

C. Lincoln Christensen has joined the Tide Water Associated Oil Co., New York, as automotive engineer, sales engineering department. He was previously technical adviser, I. Edwin Tanenbaum, Inc., New York.

Edward W. Dart has joined the Glenn L. Martin Co., Baltimore, as engineer. He was formerly chief draftsman for the Seversky Aircraft Corp., Farmingdale, Long Island, N. Y.

O. E. Szekely, president of the Szekely Corp., has announced that his company's offices and experimental laboratories have been moved from Elmira, N. Y., to Pitcairn Field, Willow Grove, Pa. He will make his headquarters at the new address.

Robert D. Byers has been appointed chief instructor and engineer, Border Cities Aero Club, Windsor, Ont., Canada. He formerly held a similar position with the Hamilton, Ont., Aero Club.

Herbert Coggins, General Motors of Canada, Oshawa, Ont., became superintendent, chassis assembly division on Oct. 1. He had been superintendent of standards, assembly division.

. . . . At Home and Abroad

Oliver F. Allen has severed his connection with the Public Works Administration in New York so as to devote more time to his practice as consulting engineer, especially in reference to Diesel engines, powerplants and internal engineering and production liaison. He continues as managing director of Martin Motors, Inc., and secretary and director of American Rezo, Inc.

Maurice J. Zucrow
Consultant

Maurice J. Zucrow has established an office as consulting engineer at 415 N. LaSalle St., Chicago. He was previously research engineer, Republic Flow Meters Co., Chicago.

R. C. Allan, who has served as assistant sales manager in the carburetor division of Bendix Products Corp., now heads the sales department of the same division. His headquarters are in Detroit.

Earle A. Wiener has charge of Lincoln and Zephyr service at the R. E. Moorhead Agency, Mansfield, Ohio. He was formerly assistant service manager, Ad Adams, Inc., Cleveland.

Leroy R. Ruoff has joined the staff of Detroit Compensating Axle Corp. as sales engineer. He was formerly manager, Truck Equipment Co., Long Island City, N. Y.

Herbert Hartley, formerly technical officer, mechanical section, Shell Co. of Australia, Ltd., Sydney, has been promoted by his company and transferred to its head office in Melbourne to take charge of testing and research work, mechanical section.

Lester F. Campbell is engineer with Pratt & Whitney Aircraft, division of United Aircraft Corp., East Hartford, Conn. He was formerly assistant chief inspector.

John W. Oehrli has been named chief engineer, Lycoming Manufacturing Co., Williamsport, Pa. He was previously engineer in charge of design.

At Truck Show Banquet

Walter A. Olen, president and general manager, Four-Wheel Drive Auto Co., was the principal speaker at the National Motor Truck Show banquet, Newark, Nov. 11. Martin Schreiber, Public Service Coordinated Transport Co., was toastmaster.

John F. Winchester, president of National Motor Truck Show, Inc., and manager, automotive department, Standard Oil Co. of N. J., was presented with a testimonial parchment expressing appreciation for his work in the motor truck industry.

Many other SAE members were seated at the speakers' table.

Forest S. Baster has been named chief engineer of The White Motor Co., Cleveland. Before this promotion he was assistant chief engineer in charge of engines.

Harry D. Goldstein, formerly draftsman, Naval Aircraft Factory, Philadelphia, has been made junior aeronautical engineer.

William P. Kennedy, general manager, Brodie System, Inc., is author of "A Scientific Service," an article appearing in the October issue of *The Marine News.*

Anatoly M. Kriguer has been named head of engineering department, Autozavodim. Molotva, Gorky, U.S.S.R. He was previously assistant chief chassis designer.

Fred C. Booth, who has been connected with the Ford Instrument Co., Long Island City, N. Y., has joined the Sunnen Products Co., St. Louis.

R. M. Barnhart, a graduate of the University of Detroit, has been named chief engineer of Brown Industries, Spokane, Wash.

Earl M. Sawyer has resigned his position as superintendent of equipment, New Hampshire Highway Garage in Concord, to accept a position as purchasing agent for the Carl Frink Manufacturing Co., Clayton, N. Y.

Seiji Konishi has been appointed assistant factory manager, Kawasaki factory, Tokyo Jidosha Kogyo Co., Japan, manufacturers of trucks, buses and tractors. He formerly was chief designer, automotive department, Tokyo Gasu-Denki Kogyo Co., Ltd.

Samuel F. Arbuckle

Samuel F. Arbuckle, who is credited with having invented the double-filament automobile headlight and tail light bulbs, died of a heart attack, Oct. 12, while in New York on a business trip. He was president of the Samuel F. Arbuckle Corp. and the United Lens Corp., and made his headquarters in Detroit.

Mr. Arbuckle, who has been described as "a genius in various matters electrical," became a member of the Society in 1920. At that time he was affiliated with the U. S. Automotive Corp., Connersville, Ind. In 1922 he was named vice-president and general manager of the Monogram Lens Co., Detroit, and continued in that position until 1931 when he became president of the United Lens Co.

His interest in automotive electrical equipment dates back to 1913 when he was affiliated with the Ordinance Dimmer Co.

Mr. Arbuckle was born in Indiana in 1885 and was educated at Georgetown and J. B. Stetson Universities.

Donald P. Stokke

Donald P. Stokke, a junior member of the Society, died on Oct. 30. Mr. Stokke was employed as inspector by the Pratt & Whitney Aircraft Co., East Hartford, Conn., with which he had been affiliated since 1935. Prior to that he had been a partner in the Reliable Auto Sales Co., and a dynamometer operator with the Ray Day Piston Co. He was 25 years old and a graduate of the Polytechnic Institute of Brooklyn.

News of the Society

(*Continued from page* 17)

the resistance and disturbance of the air through which the plane passes will cause new and insurmountable problems. In order to move through the air at a speed much faster than 500 m.p.h., he believes, will require some different machine, perhaps a rocket.

Mr. Sikorsky was introduced by Rex B. Beisel, assistant chief engineer, Chance Vought Division of United Aircraft Corp., who presided at the meeting.

A preview of 1938 cars by Joseph Geschelin was the feature of the Oct. 26 Southern New England Section meeting. Although the layman will see nothing radical in the new models, the trained eye of the engineer sees great advances over last year, said Mr. Geschelin, who is Detroit technical editor for *Automotive Industries*. The 1938 models, he added, present an outstanding display of sheet metal engineering.

Engines, the speaker continued, have not been subjected to revolutionary changes, but time-tested units have been refined and made more efficient. Progressive mechanical advancement has been made in riding quality, frame rigidity, and features tending toward safer and more vibrationless performance, he added.

Hypoid axles, Mr. Geschelin reported, have been almost universally adopted and the remote gear shift is making headway on the more expensive models. He likewise noted that steering gear reductions have been cut down in many cases, which, he said, may be a safety factor. The move toward battery-under-the-hood arrangements, he believes, should be well received.

Accessories Crowd Car Interior, Oswald Claims

• Detroit

Designers are sacrificing automobile body roominess and accessibility features to provide space for the adjuncts of the modern motor car, according to John Oswald, chief body engineer of the Olds Motor Works, Lansing, Mich. Addressing the Detroit Section at the Hotel Statler Oct. 18, he added that the present tendency to encroach on body roominess had resulted in tunneling and poor placement of such accessories as heaters and radios. Floor lines and roof lines, he declared, have been dropped too low, handicapping the automobile passenger in getting into the car or out of it.

"Let me emphasize," he said, "that regardless of what the style or construction of the future automobile may be, first and foremost the car buyer and his reactions must be considered. He has come to expect a great deal in the way of riding comfort, refinements, roominess, ease of access and control and these things must not be sacrificed to accommodate the mechanical features of the car. The interior of an automobile should be in keeping with the modern living room where the user can relax. Operating a car should prove just as comfortable and enjoyable as sitting in an easy chair at home."

In discussing this phase of Mr. Oswald's talk, J. E. Schipper, editor of the Detroit Section's *Supercharger*, asked why passengers as well as the driver had to be seated in the same uncomfortable upright position when the passengers should be permitted to relax. In reply, Mr. Oswald declared that the irregular roads of today would make an "easy chair" position quite uncomfortable. The railroads, he said, have agreed after experimentation, that the most vertical sitting position is the most comfortable for long trips. Lively discussion of this question arose on the floor, with bus engineers declaring that reclining seats with headrests had introduced a higher degree of comfort in buses.

In his paper Mr. Oswald expressed doubt that the rear-engine car would be adopted soon, although he admitted many of its advantages over the front-engine car. Probably much nearer realization, he declared, is the unit type of construction as against the present type in which the frame and chassis are a separate unit from the body. However, he declared that with present construction the industry has a great deal more flexibility for making changes and improvements in appearance and manufacture, whether it be on the body, chassis, or both.

If the body of the future car contains all the principal members of the frame, the dividing line between chassis and body will disappear, he said, in which case the body designer will be responsible for a greater unit. This may mean a reorganization of the whole structure of the motor car industry both from the standpoint of designing and manufacturing. Greater ingenuity will be required of stylists if the unit type construction comes, he said, for naturally the unit construction will require more experimental work than has been done before and after a structure has been worked out to stand the gaff of the highways there will be a more or less standard procedure in construction which may handicap stylists.

Floyd F. Kishline, chairman of the Detroit Section, asserted the chassis engineer's viewpoint, with the declaration that body weight has increased at least 100 per cent in the last 15 or 18 years. This aroused keen discussion on the problem of obtaining stiffness of the combined body and chassis units, particularly in the case of convertible type cars. The suggestion was offered that the creation of new automotive materials will influence construction manufacture more than it has in the past. Mr. Kishline offered the opinion that "whether we like it or not, and almost without knowing anything about it definitely, the body and chassis are gradually approaching the unit construction."

The customer was pictured as an expert on the use of products rather than a critic of design, when Henry G. Weaver, director of the customer research staff of General Motors Corp., addressed a joint meeting of the Aeronautic-Junior-Student Activities of the Detroit Section, Oct. 11. Mr. Weaver advised his engineering audience to recognize this function of the consumer and adhere to the philosophy: " — finding out what people *like* and doing *more* of it" . . . " — finding out what people *don't like* — doing less of it."

He described customer research as an operating philosophy rather than an isolated functional activity, and outlined his methods as: (1) finding out what the customer wants, (2) building the product the way he wants it, consistent of course with sound engineering, (3) describing the product or the service in the same language the customer uses in expressing his wants, (4) synchronizing sales and service procedures with customer psychology and buying habits.

Mr. Weaver decried the common conviction of almost everyone that he or she can work up an effective questionnaire of the kind used in customer research. Himself a graduate mechanical engineer, he declared that this unexplored field of customer research is destined to become recognized as a profession comparable to the profession of cross-examination in the legal field. In that connection he added that the most helpful guidance he has found is in legal text books dealing with the technique of cross-examination.

Money spent by American manufacturers in advertising and the development of foreign trade, particularly in Central and South America, is jeopardized by inability to service equipment sold in these territories, according to John Schlegel, director of foreign trade relations for the Pan-American Airways System, and second speaker on the program.

Manufacturers of automobiles, tractors and high precision machinery are benefiting directly from development of air lines by Pan-American, he said. He predicted that trans-Atlantic operations will have a marked effect on the sale of precision machinery in Europe because of the importance of the time element in supplying replacement parts for such equipment. He illustrated this with an example of an American Diesel manufacturer unable to meet German competition in South America on an engine because his price was four or five hundred dollars above that of the German Diesel. Quick replacement service by air line from the United States enabled this manufacturer to put Diesels in operation with only $100 worth of spare parts on hand, while the foreign engine required five or six hundred dollars worth of spare parts to assure continuity of operation. This applies also in the sale of automobiles in South America, he said.

Definite plans for trans-Atlantic service were formulated by Pan-American seven years ago and the South American routes have served as a testing ground for equipment and personnel, he added.

Floyd Kishline, chairman of the Detroit Section, presided at the meeting with A. C. Hazard, chairman of the Junior Student Activity, introducing Mr. Weaver. Prof. W. F. Gerhardt, of Wayne University, introduced the Aeronautics Activity speaker. The session was closed with motion pictures flown from New York to Detroit by American Airlines on a plane that arrived during the meeting.

Reviews and Predicts Cooling System Progress

• Washington

That the place of the radiator engineer will be taken by the cooling system engineer, was the prediction made by L. P. Saunders, director of engineering, Harrison Radiator Corp., in his talk before the Washington Section, Nov. 9. He showed that year by year the demand upon the automobile's cooling system has been increasing, despite advances made in road economy and other factors of performance.

To prove that cooling systems have met these demands during the past half decade he quoted figures to the effect that despite the fact that engine sizes have increased 6.5 per cent and frontal areas have decreased 12 per cent, heat dissipation (B.t.u. per sq. ft. frontal area) has increased 70 per cent during the same period.

Mr. Saunders believes that more attention should be paid to antifreeze tests before cars are actually put into production. "A 50-50 mixture of alcohol and water," he said, "has a very much lower volumetric heat capacity than that of water. I believe it is highly desirable to run dynamometer tests with antifreeze mixtures, shutting the engine down at various operating temperatures to measure actual quantity of liquor loss."

Oil cooling, he believes, will eventually come into its own, and oil coolers will be put on

cars for the specific purpose of providing better operation from the owner's point of view.

In concluding his talk Mr. Saunders stated: "Whether or not the radiator will maintain its present position on the front of the automobile remains to be seen. Any and all ideas regarding other positions may now be considered, no matter how wild they may seem at first. New types of cores may be forthcoming, as well as new locations for fans, overflow tanks and filler caps. With the cooperation of body designers I believe that we may have new front-end designs that will benefit all of us."

Admitting that to predict is to lay oneself open to ridicule, he stated his belief that "pressure systems may develop in which the water jacket will operate under much higher pressures than those now in use and fans will operate under higher pressures, so that looking back in the light of new knowledge, it would be impossible to 'sell' the idea of a cooling system similar to those in use today."

Among those taking part in the discussion were Lieut. Com. R. Botta, Dr. H. C. Duus, Maj. A. H. Foster and others.

Praises Engineers for Fine Job on 1938 Cars

• New England

Motorists are getting more efficiency, safety and added dollar value in the 1938 cars, Dean A. Fales, of the Massachusetts Institute of Technology engineering department, told the members of New England Section, at his annual review of the present models, Nov. 9. He stated that this year the makers went about the work of improvements and refinements in an orderly manner and did a fine job.

"Engineers improved on valves, pistons, engines, lubrication, cooling, pumps, brakes, bodies, frames, springs, vision and other units," he said, adding, "But the motorists do not realize it because all of these things are out of sight. Yet they get the results in the way the cars ride and handle.

"It would not have been sensible to scrap dies worth millions of dollars to try to make radical changes this year. As eye appeal is considered about 85 per cent of the sales value and the 1937 bodies were excellent there was no need to change the lines very much.

"The manufacturers decided to let the motorists decide whether or not they want the new types of gear shifting by making them optional equipment. People do not realize the extensive experiments that are made at great cost to prove such devices are right. If the public decides it wants them they will later become standard equipment.

"This experimenting also covers other units. It is generally accepted that mechanical improvements go along about 5 per cent a year. So when all the units are grouped in betterments it makes a large total. This means that there is less service work on cars, which means much to owners in these days of excessive motor taxes."

Mr. Fales then outlined what has been done to make the mechanism better, taking each unit in turn. He made it easy to understand the greater efficiency built into the 1938 models. He predicted that more cars will have the coil springs in the rear instead of leaves next year.

"Independent wheel springing is growing all over the world," Mr. Fales said. "Many ask about its use on all four wheels. Indications are now that we need one axle at least to hold the car on the road. That does not mean we shall not have independent springing on all four wheels in the future. More experimentation will be needed to get final approval by the manufacturers.

"There is no question but what the makers are safety-conscious. Today's cars are built so mechanical failures are negligible. We at Tech

President Woolson Visits Pacific Coast Sections and Colorado Club

VISITING the West, SAE President Harry T. Woolson was honor guest at October meetings of the Northern California, Oregon and Northwest Sections of the Society and the SAE Club of Colorado. John A. C. Warner, secretary and general manager of the Society, accompanied Mr. Woolson on his visits to the Pacific Coast Sections, and both men were present at the National Aircraft Production Meeting in Los Angeles, Oct. 7-9. There they visited with members of the Southern California Section.

In the above pictures: (1) Mr. Woolson is about to bring his moving picture camera into action with (2) Howard Baxter and Harry LauFer, Northern California Section chairman, as the subjects. At Seattle (3) W. W. Churchill, chairman of the Northwest Section and Mr. Woolson are guests aboard Stanley W. Donogh's yacht, as is (4) Mrs. Woolson who is pictured with her hostess, Mrs. Donogh.

From Portland (5) Mr. Woolson and a group of Oregon Section members visited Timberline Lodge, high on Mt. Hood; (6) Joseph P. Seghers, Oregon Section chairman, stands at the door of the lodge.

The candid-camera man was not on hand to photograph Mr. and Mrs. Woolson with members of the SAE Club of Colorado, as they visited the gold mines at Idaho Springs and were guests at a specially arranged Welsh luncheon at Central City, outside of Denver.

are working all the time to find the cause of motor accidents. We found that simple things like a loose cover on a battery allowed fumes to get into a car and bother driving. Putting the battery under the hood will prevent this.

"We have found that one of the real dangers is the gas that comes from the breather pipe. No one has yet discovered just what type of gas it is but it certainly is very bad. Taking the gear-shift lever out of the floor will plug up that hole against fumes.

"What effect putting headlights into the fenders will have on safety remains to be proved. The question arises as to whether or not the vibration of fenders will throw the lights out of adjustment. If a fender is hit in a bump and is not repaired properly the light will not be right.

"We are not going to cut down accidents unless owners keep their cars fit to drive. In Massachusetts we have two compulsory inspections a year. They are very good, but should be more strict, especially for cars eight and nine years old." He paid a high tribute to the tire manufacturers for the excellent product they are turning out to keep pace with the automotive improvements in power.

Mr. Fales then told of an interesting check up on speed. "A number of physicians who go to Florida each winter agreed to make a check up. They drove at varying speeds. Their report was that 50 miles an hour is fast enough. They said when driving at a higher rate there was nerve tension that is not good for drivers." At the end of his talk, Mr. Fales, who is past-chairman of the Section, answered questions for more than an hour. He was introduced by Section Chairman John H. Walsh.

Vision-Lined Tractor Engine is Developed

● Milwaukee

Automobile engineers have paid considerable attention to the matter of vision, but the tractor men have gone them one better—they have designed an engine that is easy to look past.

A. W. Lavers, chief engineer, tractor division, and W. E. Swenson, engine designer, Minneapolis-Moline Power Implement Co., told members and guests of the Milwaukee Section about it Nov. 5 in their paper "A Vision-Lined Engine for a Vision-Lined Tractor." Mr. Swenson did the speaking, and Mr. Lavers, who was SAE Tractor and Industrial Power Equipment vice-president in 1936, took part in the discussion.

The first step in meeting the demand for a narrow engine, the authors stated, was to eliminate, as much as possible, the bumps caused by air cleaners, magnetos, manifolds and other adjuncts of the engine. Compactness was achieved by departing from the more conventional layout, they said, explaining that the valves are horizontal and the rocker arms are vertical, acting directly between the camshaft and valve stems. No push rods are used. The cylinders are blind bored, as part of the combustion chamber is cast with the block. They stated further that the "head" bolts on the side and contains the spark-plugs. Various compression ratios are obtained by making it either concave, flat or convex. It was explained that, as no working parts are affected by changing the "head," the arrangement makes it extremely simple to change compression ratios.

The engine is of 3⅞ in. bore by 4½ in. stroke and, burning gasoline, develops 32.5 hp. at 1500 r.p.m., with a 4½ to 1 compression ratio.

The authors described in detail the crankshaft, which is mounted on two ball bearings. Elimination of the center main bearing, they said, does away with the necessity of having an oil pan.

It was found necessary to study crankshaft deflection carefully and the apparatus developed for this purpose was described. It consists of a mirror mounted slightly off center on the end of the shaft which reflects light from an arc light on a photographic film. The reflection is a true circle when the engine is driven by a dynamometer, the authors explained, but when the engine carries a full load the circle is irregular to a varying degree depending on materials used and the design of the shaft. The apparatus is calibrated so that the quantity of deflection can be determined. Different materials were used and steel was selected over cast iron. The shaft used in production deflects about 0.01 in. at full load and rated speed.

An unusual opening was provided for the meeting. The entire glee club of the Waukesha Motor Co. turned out in formal attire stimulating the remark that "musical talent and engineering skill go hand-in-hand."

The Milwaukee Section welcomes students of nearby colleges and universities to its meetings, and has reduced the costs of pre-meeting dinner tickets for those who are student members of the Society.

Predicts Design Changes To Meet New Market

● Chicago
● Canadian

Automotive engineers in the next year face the most intense challenge to their ingenuity that they have ever experienced, Norman G. Shidle, executive editor, SAE JOURNAL, predicted in talks before the Chicago Section, Nov. 8, and the Canadian Section at its Montreal Meeting, Nov. 22.

Mr. Shidle sees the objective of automobile design changing from trying to give customers more for their money toward giving them the same in comfort and performance for less money. About 60 per cent of all the automobiles in use in American cities, he pointed out, are owned by families whose income is less than $2000 per year.

Body engineers and stylists, he said, may make an important design contribution by attempting consciously to move toward a style which would require lighter rather than heavier bodies. Radical style changes can be brought about gradually, he added, pointing to the differences in appearance between the 1938 models and those of 10 years ago as proof.

Current styles are more simple than those of the past, he said, stating that in many current models the very simplicity itself is startling.

Injected into the economic background which seems developing to frame them, it is quite within the realm of possibility, he concluded, that still more simplified cars in the future might create quite a sales sensation.

Members Test, Then Discuss 1938 Cars

● Metropolitan

The stereotyped gear-shift lever will soon be a thing of the past, contended Austin M. Wolf, consulting engineer, summarizing design developments in 1938 cars at the Metropolitan Section Meeting, Nov. 16. Devoted to a discussion of new models in which Mr. Wolf and car company engineers answered a volley of written questions, the meeting followed the Annual Proving-Ground Outing at Roosevelt Raceway, Westbury, L. I., at which 250 turned out to test thirty 1938 models, furnished through the courtesy of their manufacturers, over the straightaways, hairpin turns, and rough road of the course. Intent not only on "driving all three" but on trying out all 30, the enthusiastic turnout kept the new cars running continually from morning until dark.

New arrangements of the gear shift in the new transmissions, continued Mr. Wolf, not only clear the front seat of obstruction but shut out noise formerly admitted by the old gear shift lever. In addition to transmission developments other highlights of the '38 models were named by Mr. Wolf as spring suspensions, exemplified by Buick's rear coil springs; new notes in styling, found in Lincoln Zephyr and Graham; the Cadillac-16 engine, and the Buick piston. Mr. Wolf then took up detail design features car-by-car, and concluded with an explanation of the mechanical complexities of the Oldsmobile semi-automatic transmission.

Before selecting the present type of semi-automatic transmission, we tried out a roller-type of transmission with an infinite number of speeds that was a delightful thing to drive, said H. M. Crane, General Motors Corp., explaining that it had to be rejected because its cost appeared to be prohibitive. He pointed out that the present design should not be considered the ultimate answer, and that a simpler solution of the problem is naturally hoped for.

The year 1911 was a critical one in the history of the automotive industry, recalled SAE Treasurer David Beecroft, Bendix Products Corp., in an introductory speech in which he reviewed the industry's history. In that year, he continued, the Selden patent suits were settled, the SAE Standardization Program was started, the first 500-mile race was held at Indianapolis, and Cadillac came out with the first self-starter.

As ground committee chairman, Harold F. Blanchard arranged the proving ground outing through the courtesy of Major George H. Robertson, vice-president and general manager of the Roosevelt Raceway. Robert M. Cregar, vice-chairman, Passenger-Car Activity, was chairman at the dinner meeting.

Newark T. & M. Meeting

(Continued from page 17)

tunnel at the time. Fire-fighting equipment is available, as are wrecking cars, "but a gasoline fire in a tunnel is not the same sort of thing as a gasoline fire out in the open, where lucky motorists can get out of their cars and retreat to an open field," he said.

Joseph A. Anglada, consulting engineer, New York, analyzed the 1938 offerings by truck and parts manufacturers in his lucid paper "Development and Trend in Truck Designs," at the evening session. "The point has been reached where gains in truck performance and life result chiefly from the cumulative effect of continual refinements, rather than from radical departures from established principles of design," he said, following a brief historical résumé of the gasoline truck's progress.

"Trucks are now more economical and silent, speedier, more easily handled, and better-looking than was thought possible but a short time ago," he said, pointing out that there is an increasing desire of the truck customer to obtain more suitable vehicles for his work. Increased intelligence in maintenance, and in keeping up the appearance of trucks is encouraging, he stated.

Under the chairmanship of T. L. Preble, general chairman of the meeting, the Wednesday afternoon session heard F. K. Glynn, engineer, American Telephone & Telegraph Co., expound the "Economics of Truck Selection." Shrewdly analyzing the requirements to be satisfied in a given transportation operation, Mr. Glynn gave examples to show how a fleet operator should make his choice as to type of vehicle. "There are chassis available to meet any kind of requirement, no matter how special," he said, and advised buyers to take advantage of bulk purchases by planning purchases ahead of time and

Speakers and Discussers at Newark T. & M. Meeting

Photos by Leslie Peat, Field Editor, Metropolitan Section

C. Eustace Dwyer
Merrill C. Horine
Clinton Brettell

L. C. Josephs
Capt. Oscar A. Axelson
Clayton Farris

Billings Wilson
John G. Moxey
G. Waine Thomas

arranging for delivery at specified times during the year.

Many operators, he thinks, overlook the fact that the total cost of transportation over the life of the vehicle is the all-important factor in making truck purchases.

Ratings given vehicles by manufacturers came in for a round of vigorous discussion from the floor. B. B. Bachman, vice-president of Autocar Co., pointed out that engineers were forced by competition and by the various requirements of state regulatory bodies to "up" their ratings. Agreeing were G. Waine Thomas, chief truck and bus engineer, Reo Motor Car Co., Lansing, and Austin M. Wolf, consulting engineer, New York.

Capt. Oscar A. Axelson, Columbia Gas & Electric Corp., New York, asserted that too little attention is given by truck manufacturers and many operators to the question of relative gasoline economy. Clinton Brettell suggested that two basic ratings of trucks might well be established: one for short delivery route operations and one for long-haul operations.

John G. Moxey, transportation engineer, Sun Oil Co., Philadelphia, braved a vigorous clash of opinion in presenting his forceful paper "Semi-Trailers vs. Six-Wheelers" at the Wednesday evening session under the chairmanship of George T. Hook, editor, *Commercial Car Journal*. Lauded by many from the floor as a basic contribution to the literature on "engineered transportation," the paper emphasized the need for an operator to study carefully his own transportation problem, and to project his estimates into the future so that he could buy the type of vehicle which would show the greatest operating profit.

Discussion finally resolved itself into several clear-cut issues: Are semi-trailers and six-wheelers fighting over the same bone, or does each have a definite field where it alone can prevail? If each has its particular field, what is it? New terminology was introduced by one of the more impartial speakers who called the six-wheeler a "rigid six-wheeler," and the semi-trailer an "articulated six-wheeler" in pointing out that the semi-trailer is simply an adaptation of the six-wheeler, and both are the offspring of a common ancestor, the four-wheeler.

Rated as less than a half-truth by the several discussers were the claims made in certain advertising literature that "a truck can pull more than it can carry and it is easier to pull a load than to push it." Stanch defenders were not lacking, however, who offered to demonstrate its truth practically or mathematically, or to justify it on the grounds of "poetic license."

Formula for Service Presented by Houser

• Cleveland

Automobile service can be expressed by the formula: $S = P^3 + C$, when S stands for service; P^3 for profit, policies and personnel; and C represents the customer, W. A. Houser, general parts and service manager, Cadillac Division of General Motors Corp., told those attending the Nov. 9 meeting of the Cleveland Section.

When a general complaint occurs on any one model, he advises: first, that it be fixed as soon as it occurs or before, and second, that a complete report of the trouble be sent to the factory so that it may be corrected at its source. He emphasized the value of field reactions, but noted that they are effective only if it is made easy for service men to report the trouble, and for factory men to correct it. He recommends that reports be concise and that they be routed through the factory to assure that something be done about them in spite of any departmental jealousy or feud.

Mr. Houser noted the necessity of having policies carefully planned and consistent. Free service, he stated, is perhaps one of the greatest sources of trouble. It must be subject to reasonable interpretation by the man in the field, and authority must be given him to render such service after expiration of the new-car warranty. He also declared that the car manufacturer and his dealer must be responsible for servicing all parts of the car – the car was sold in one piece and should be serviced in the same way.

Proper attitude of the field personnel is better than expert knowledge, Mr. Houser believes, and noted that it is good policy to keep in mind that the customer is boss. The product and the service are good only in the mind of the customer, he added, and noted further that in the aggregate, the customer is always right, although individually he may be wrong.

Extols New Cars at International Luncheon

National Automobile Show visitors from abroad heard John A. C. Warner, SAE secretary and general manager, outline the technical improvements in the new cars as he spoke at the International Luncheon sponsored by the Automobile Manufacturers Association, Ritz Carlton Hotel, New York, Oct. 28. This year, he said, manufacturers seem to have concentrated more than ever before on getting results for the driver rather than mere talking points to attract the buyer. The engineers have made the new cars both more pleasant to drive and safer to ride in, he declared, and brought attention to many of this year's refinements that have helped accomplish these objectives.

Alfred Reeves, vice-president of the Automobile Manufacturers Association, who shared the program with Mr. Warner, gave an enlightening address on "What's Ahead for the Automobile Industry." B. C. Budd, vice-president of Packard Motors Export Corp. and a member of the A.M.A. Export Committee, was toastmaster. Presiding at the luncheon was Robert C. Graham, vice-president of Graham-Paige and chairman of the A.M.A. Export Committee.

Upholstery Defined as An Engineered Fabric

• Canadian

Textiles are engineered for automotive upholstery just as engines, wheels, transmissions and other parts of the present-day automobile are engineered for the purposes they serve, Dr. W. F. Bird, director of research and technical control, Collins and Aikman Corp., told members and guests of the Canadian Section at its Oct. 20 meeting.

Inspiration used to guide textile manufacturers in making a fabric just as it guided the old-fashioned housewife in making a cake, and with the same results, sometimes good and sometimes bad, he declared. At that time, he added, "day-to-day quality of the same material varied greatly because each foreman who had charge of the different operations regulated the processing of the material; not according to basic engineering principles, but according to his judgment and the state of his digestion."

Advanced thinkers in the industry who advocated using basic scientific and mechanical truths in building fabrics were besieged on all sides by "old timers" who believed that such a thing as absolute control of quality, or forecasting all manufacturing methods was impossible, because the raw materials used are not standardized or controllable, Dr. Bird said. There were terrific inhibitions to overcome, but they were pushed aside, and as a result the textile industry has made long strides towards its goal, he added.

The textile industry, working with automotive men, he said, determined tangible requirements that an ideal automobile upholstery fabric must possess, namely: long life and ability to take hard knocks; maximum style and beauty; ease of handling; elasticity and softness; ventilation for dissipation of body and interior heat; maximum resistance to spotting.

Dr. Bird explained that, with these objectives in mind, textile engineers built "brick-by-brick" from information gathered by scientific research to obtain a new fabric "which is not an inspiration, which is not a novelty, but which is a basic product built on a solid foundation of basic engineering principles," adding, that it is an especially engineered fabric built to serve only the purpose for which it is made—a fabric for automobile upholstery.

"This development is not the end," Dr. Bird declared. "Textile men will never rest. Further accomplishments will be attained."

Col. Fred W. Miller, general manager of Collins and Aikman of Canada, Ltd., and Quebec regional vice-chairman of the Canadian Section, introduced the speaker. After the address a motion picture was presented and then the meeting was opened for discussion. Section Chairman W. E. McGraw presided.

Wolf Gives Views on 1938 Design Trends

• Baltimore

More than 90 members and guests of the Baltimore Section met, Nov. 4, at the Longfellow Hotel to hear Austin M. Wolf, automotive consultant, impartially comment on the outstanding features of the new automobiles in his paper, "1938 Design Trends," which was published in full in the November issue of the SAE JOURNAL. Dinner was served before the meeting.

"Chemical Hay" Subject of R. E. Wilson Talk

• Pittsburgh

"Chemical Hay for Mechanical Horses," as described and explained by Dr. Robert E. Wilson, president of the Pan-American Petroleum and Transport Co., stimulated considerable discussion at the Oct. 19 meeting of the Pittsburgh Section. More than 100 members and guests attended the pre-meeting dinner and 60 others came in later to hear Dr. Wilson tell of the change in production and use of gasoline during the past three years, fundamental problems facing the industry, and their probable solutions.

Dr. Eugene Ayres, staff chemist, Gulf Research & Development Co., opened the discussion by asking whether or not the government would permit the waste which would occur from the hydrogenation of coal. In answer Dr. Wilson said that since coal reserves so far exceed petroleum reserves, some foreign countries are already placing high taxes on petroleum to encourage the use of low grade coal and lignites in this manner.

The various ways of putting butane gas directly into the engine via a mixing valve by vaporization were brought out by George W. Brisbin, Peoples & Columbia Natural Gas Companies. Others discussing Dr. Wilson's paper were Stephen Johnson, Jr., John M. Orr, Charles R. Noll, D. C. Johns and Section Chairman Ralph Baggaley, Jr.

Average Car Said to Operate 2100 Hours

• Tulsa Group

From factory to junk pile in 2100 operating hours. That short, short story tells the life of the average automobile according to L. C. Eldridge, Shell Petroleum Corp., in his talk before the SAE Tulsa group at its Nov. 5 meeting. Industrial equipment having the same life would operate only 87.5 days on a 24 hr. per day basis, or 262.5 days on an 8 hr. per day basis, he pointed out, and asked "why are we so willing to accept as a matter of course a rate of depreciation in the usage value of our personal automobile that if applied to industrial equipment would render business bankrupt in an incredibly short time?"

He partially explained this by noting that industrial equipment generally operates with more constant speed, load and at more constant temperatures than do motor-vehicles. In view of these conditions, he said, they can be better supplied with a lubricant more accurately suited to their needs.

But, he said, the motor-vehicle owner can prolong the useful life of his car if he "treats it with reasonable care at all times; avoids overheating; keeps it in good mechanical adjustment. By far the most essential thing, however, is to give it the best lubrication possible." The trouble is, he continued, that when the car owner actually seeks advice on how to assure the best possible lubrication for his car he gets one answer from the manufacturer, another from his mechanic, and a third version from the local oil vendor. "He is confronted with a confusing mass of conflicting recommendations."

Mr. Eldridge regretted that "there is in existence today no definite proven data that will enable any one to answer the question as to how many miles cars in general should be driven between crankcase oil changes," and listed the many factors that enter into the problem.

"Any unbiased recommendations," he said, "must be based upon the necessity of keeping the motor as clean and free as possible of dirt, particles of worn metal, free carboneous or asphaltic materials, harmful acid formations, moisture and dilution." To assure this he recommends:

1. Completely drain and flush the crankcase and refill with clean oil whenever the oil becomes badly contaminated.
2. Starting with a light oil for a new car, increase the body of the oil consistent with the increase in running clearances developed by wear.
3. Service the air cleaner at regular operating intervals, taking into consideration the degree of dustiness encountered.
4. If an oil cleaner is used, be sure to renew the cartridge or filtering unit whenever it becomes saturated with contamination.
5. Give the engine and oil a chance by keeping the cooling system clean and free from scale, thereby preventing operating temperatures from being excessive.

Mr. Eldridge emphasized that "oil filters can be justified only as aids to clean oil, and do not eliminate the necessity of changing oil."

Another paper was presented by R. R. Sloan, Buda Engine Service of Tulsa, on "Why Use Good Lubricating Oil." He carefully explained the functions of a lubricating oil and pointed to the effects of faulty lubrication. "It is a mistaken idea," he said, "that specifications can be developed to describe the characteristics of suitable lubricants as distinguished from unsuitable grades, or to depend upon specifications in the purchase of an oil. Existing physical tests of a highly refined product will often coincide closely with one of poor quality. The only way to insure against loss of power, added maintenance cost, and shorter engine life is to buy an oil which is chemically stable, readily forms tough heat- and pressure-resisting film and has ability to separate easily from impurities, an oil of the best quality produced by a reliable refining company."

D. G. Proudfoot, Phillips Petroleum Co., introduced the speakers and presided during the discussion which kept the meeting open long past scheduled closing time.

SAE *Coming* EVENTS

Baltimore—Dec. 2

Longfellow Hotel; dinner 6:30 P.M. Handling Traffic Safely on Highway and City Streets – Clarence B. Taylor, Maryland Highway Planning Survey, and Wallace I. Braun, traffic engineer, Baltimore Police Department.

Buffalo—Dec. 14

Hotel Statler; dinner 6:30 P.M. Fuels for Automotive Diesel and Aviation Engines—Dr. W. G. Lovell, General Motors Research Laboratories.

Canadian—Dec. 15

Royal York Hotel, Toronto; dinner 7:00 P.M.

Chicago—Dec. 7

Hamilton Club; dinner 6:45 P.M. Closed meeting. Some Phases of Mechanical Laboratory Test Work —Al. Brady, Chrysler Corp.

Cleveland—Dec. 13

Cleveland Club; dinner 6:30 P.M. Changes in 1938 Models – Austin M. Wolf, automotive consultant.

Detroit—Dec. 13

Detroit City Airport.

Indiana—Dec. 9

Anderson Hotel, Anderson, Ind.; dinner 6:30 P.M. Electric Furnace Brazing – H. M. Webber, General Electric Co. Afternoon plant visit and demonstration of electric furnace brazing at the Delco-Remy plant in Anderson.

Metropolitan—Dec. 15

The Roger Smith, 40 E. 41st St., New York City; dinner 6:30 P.M. Standardization and Research Horizons – C. W. Spicer, vice-president, Spicer Manufacturing Corp.

National Production Meeting

Dec. 8-10 Flint, Mich.
Hotel Durant

Annual Meeting

Jan. 10-14, 1938 Detroit
Book-Cadillac Hotel

National Passenger Car Meeting

March 28-30, 1938 Detroit
Hotel Statler

National Aeronautic Meeting

March, 1938 Washington, D. C.

Summer Meeting

June 12-17, 1938
White Sulphur Springs, W. Va.
The Greenbrier

Milwaukee—Dec. 10

Elks Club, Kenosha; dinner 6:30 P.M.

New England—Dec. 14

Walker Memorial, Cambridge, Mass.; dinner 6:30 P.M. Subject – Automotive Crusade and Crusaders of 30 Years Ago – James T. Sullivan, automotive engineer, *Boston Globe*.

Northern California—Dec. 14

Athens Athletic Club, Oakland; dinner 6:30 P.M. Aviation Meeting. East to West Coast Moving Pictures.

Oregon—Dec. 10

Imperial Hotel, Portland; dinner 6:30 P.M. Diesel Maintenance – J. L. Snead, Jr. Resume of West Coast Regional Transportation Meeting – J. Verne Savage, superintendent, City of Portland Municipal Shops.

Philadelphia—Dec. 8

Engineers Club; dinner 6:30 P.M. Automotive Metallurgy – W. J. Diederichs, metallurgist, Autocar Co.

Pittsburgh—Dec. 14

Get-together dinner and visit to the Mellon Institute of Industrial Research.

Southern California—Dec. 10

Mona Lisa Cafe, Los Angeles; dinner 6:30 P.M. Subject – Fuels and Lubricants.

St. Louis—Dec. 17

Closed Meeting.

Southern New England—Dec. 1

Bond Hotel, Hartford, Conn.; dinner 6:30 P.M. Uses of Aluminum and Its Alloys – Dr. Paul V. Faragher, metallurgist, Aluminum Corp. of America.

Syracuse—No Meeting

Washington—Dec. 14

Cosmos Club; dinner 6:30 P.M. Subject – Aeronautics.

Explains Methods of Flaw Detection

● Baltimore

The various types of instruments which detect flaws in steels were described to 40 members of the Baltimore Section by F. R. Wittnebert, equipment engineer, Sperry Products, Inc., at their Oct. 14 meeting.

He first classified flaws as inclusions, stratifications or laminations, fractures or cracks, fatigue failures and transverse fissures, and then told of methods used to find them.

The whiting method, he explained, is one in which thin penetrating oil, which has first been put on the specimen, comes to the surface wherever fractures occur and appears in the form of dark marks on a coating of white lead and alcohol which has been placed on the surface of the specimen.

Mr. Wittnebert gave details of electric methods including the filing method, in which the flaws are indicated by iron filings. He spoke of the magnaflux method, which is based upon the filing method, but which uses both wet and dry applications, also the leakage-flux method and the X-ray method.

The author described the Sperry rail-flaw-detector cars which use the Sperry gyro track recorder, based upon the electric current method. There are 17 of these cars in operation, he said, adding that their operations cover some 150,000 miles of track per year and detect fissures at the average rate of one in each ten miles of rail.

Aviation Topic of Technical Meeting

● U. of Alabama

Discussing Air Commerce Regulations and the investigation following the *Hindenburg* disaster, Professor Lunde, aeronautics department, University of Alabama, spoke before the Student Branch at that school at its first technical meeting of the year. An earlier meeting was devoted entirely to business.

Raymond J. Schneller has been re-elected chairman of the Branch, and Tom Strang, vice-chairman. The post of secretary-treasurer is to be filled by an election scheduled for the next meeting.

Sees Little Advance in New Car Performance

● Indiana

Automobile manufacturers concentrated on eye appeal in building 1938 models and made few apparent changes toward higher performance, Lee Oldfield, consulting engineer, Schwitzer-Cummins Co., declared before 150 members and guests attending the Nov. 11 meeting of the Indiana Section. He noted that there are a myriad of minor changes and refinements, but "there apparently is unanimous agreement that adding greater performance and speed would be futile . . . that we now have much more performance than we can employ with security or peace of mind."

Mr. Oldfield believes that we may hope to see semi-automatic transmissions quite generally employed by 1940 or 1941. He recalled that several years ago, in a review talk, he advanced the personal opinion that until semi-automatic transmissions permitted starting a car manually and gave the driver the option of positive and conscious control, they would not be generally accepted by motorists. These points, he believes, have been adequately covered in some of the new semi-automatic type transmissions, mentioning particularly those used on the Buick and the Oldsmobile. Full automatic transmissions, he added, might prove awkward in some of our mountainous country.

A score of members and guests took part in the discussion which kept the meeting open long after the regular closing hour. Taking prominent parts were Macy O. Teetor, Section Chairman R. M. Critchfield and Rex Hayes.

Du Pont Chemist Talks On Automobile Finishes

● General Motors Institute

Members of the SAE Student Branch at General Motors Institute heard Dr. C. J. Wells, associate chemical director, du Pont Chemical Corp., speak on "Automobile Finishes" at its first meeting, Oct. 13. Dr. Wells gave a chronological account of the development of automobile paints and finishes and the effects upon mass production.

The meeting was opened by Student Branch Chairman W. A. Hasbany, who outlined activities planned for the coming year. He then introduced R. F. Grogan, secretary-treasurer of the Branch, who gave new members of the group a short summary of the benefits to be derived by students through membership in the SAE.

Student Branch Elects Officers

● U. of Detroit

The first regular meeting of the University of Detroit SAE Student Branch, Oct. 26, was devoted to the election of officers for the forthcoming year. Following short talks by Ralph R. Johnson, industrial coordinator of the college, and Peter Altman, head of the aeronautical department, on the Society and the duties of officers, the election took place.

Edward J. Foley was elected chairman; Frank B. Wozniak, vice-chairman; and Bernard J. Stralser, secretary-treasurer. Robert H. Fredericks was appointed chairman of the membership committee; James A. Gramling, chairman of the program committee; and Joseph C. Friedel, Jr., chairman of the publicity committee.

Preliminary plans were made for active co-operation with the Detroit Section. Motion pictures, shown through the courtesy of the General Motors Corp., concluded the program.

About Authors

(Continued from page 11)

● **Donald H. Wood** ***left a teaching job at Rensselaer Polytechnic Institute, from which he was graduated with the class of '20 to join the N.A.C.A. staff at Langley Field in 1924. The next year he was assigned to the 20-ft. wind-tunnel section and since then has done intensive research on engine cowling, propellers, engine nacelle locations, airships and large airplane models. The work of this section has been under his direction since 1929.***

● **C. E. Zwahl** ***has been a General Motors man for 18 years. Before 1927 he was metallurgist with the General Motors Laboratories. In that year he joined the engineering department of Chevrolet Motor Co. as metallurgical engineer and his work since then has been devoted to metallurgical lubrication and similar problems arising in the manufacture of Chevrolet cars and trucks.***

Applications Received

(Continued from page 21)

Long, P. C., inspector, Vultee Division, Aviation Mfg. Corp., Downey, Calif.

Loxton, Samuel Harry, assistant engineer, Birmingham & Midland Motor Omnibus Co., Ltd., Birmingham, England.

Mack, H. A., division manager, Ethyl Gasoline Corp., Dayton, O.

Malnoski, John G., general manager, Muncie Malleable Foundry Co., Muncie, Ind.

McIntyre, B. D., president, Monroe Auto Equipment Co., Monroe, Mich.

Meyer, Henry C., fleet sales supervisor, Milwaukee Ave. Motor Sales, Chicago, Ill.

Miller, Leslie T., field engineer, Wright Aeronautical Corp., Paterson, N. J.

Miller, William R., proprietor, W. Miller, Vancouver, B. C.

Mueller, George A., supervisor, Young Radiator Co., Racine, Wis.

Nylander, Ernest R., vice-president and general manager, Baker Equipment Engineering Co., Richmond, Va.

Oldham, R. J., student engineer, Chevrolet-Kansas City, Kansas City, Mo.

Owen, A. Chant, equipment sales, G & O Manufacturing Co., New Haven, Conn.

Patten, Eleah G., service flat rate and tools, Pontiac Motor Division, Pontiac, Mich.

Platt, Franklin B., president, Erlinder-Platt Sales Corp., Chicago, Ill.

Poock, Albert F., Cimatool Co., Dayton, O.

Poock, Herman O., master mechanic, Inland Mfg. Co., Division of General Motors Corp., Dayton, O.

Poock, Paul W., engineer, Sheffield Gage Corp., Dayton, O.

Reilly, James E., J. P. Stevens & Co., Inc., New York City.

Richardson, Paul H., experimental engineer, Bendix Products Corp., South Bend, Ind.

Rohde, Frederick W., procurement inspector, U. S. A. Air Corps, Dayton, O.

Rowland, J. M., resident engineer, Empire Sheet & Tin Plate Co., Mansfield, O.

Smith, Stanley B., Jr., experimental testing engineer, Pratt & Whitney Aircraft, E. Hartford, Conn.

Squier, Carl B., vice-president and sales manager, Lockheed Aircraft Corp., Burbank, Calif.

Steele, Walter B., service manager, Oak Ridge Buick Co., Inc., Tuckahoe, N. Y.

Stephen, A. F., thermostat engineer, Dole Valve Co., Chicago, Ill.

Stickney, Wilder Curtis, assistant engineer, Gulf Research & Development Co., Pittsburgh, Pa.

Sutherland, Frank B., garage superintendent, Atlantic Refining Co., Philadelphia, Pa.

Talmage, Charles Robert, sales engineer, Moraine Products, Division of General Motors Corp., Dayton, O.

Sweetman, John Richard, 5 Midland Ave., Hawthorne, N. J.

Thompson, Francis B., engineer, Consolidated Aircraft Corp., San Diego, Calif.

Van Wamelen, J. W., Jr., chief, technical department, Royal Automobile Club of Holland, The Hague, Holland.

Van Zee, Ben G., assistant chief engineer, Tractor & Engineering Division, Minneapolis Moline Power-Implement Co., Minneapolis, Minn.

Vyvyan, Wesley W., draftsman, Pontiac Motor Division, Pontiac, Mich.

Walker, Theodore F., draftsman, Pontiac Motor Co., Pontiac, Mich.

Walker, William C., instructor, Board of Education, San Bernardino, Calif.

Wannenmacher, Harvey F., supervisor transportation, New York State Electric & Gas Corp., Lancaster, N. Y.

Warner, W. O., president, Warner Aircraft Corp., Detroit, Mich.

Weckler, Herman L., vice-president, Chrysler Corp., Detroit, Mich.

Young, Melvin Richard, service representative, Pontiac Motor Co., Washington, D. C.

What
Foreign Technical Writers Are Saying

AIRCRAFT

Airscrew Blade Vibration

By B. C. Carter. Published in *The Journal of The Royal Aeronautical Society*, September, 1937, p. 749. [A-1]

During development of solid metal airscrews in the U. S. many vibration failures occurred and various investigations have been made there and elsewhere with a view to overcoming such troubles, the author states, and contends that the problem is to avoid airscrew failures while keeping weight as low as possible; its solution involves mathematical analysis, further development of experimental methods, and investigations in relation to particular combinations of engine and airscrew.

Approaching the subject as an extension of crankshaft torsional vibration investigations, the author, in association with his colleagues at the Royal Aircraft Establishment, has made extensions in the mathematical treatment which serve to clarify ideas concerning the modes of vibration that may occur and also to form a new basis for experimental investigation. The essentials of this treatment are described in the paper, to which there is an appendix giving a brief mathematical examination of flexural vibration of elastically encastred blades.

The results of some vibration experiments on a stationary magnesium airscrew are given and comparison is made with the results of theoretical investigation. Also, a new experimental technique is described whereby photographic records may be obtained of blade-tip vibration relative to the hub in flight. An interesting feature of this method is that a flash lamp bulb is secured to the blade-tip to form a light source. So far, records have been obtained on the hangar only; some results of analysis are given.

Variants of a new device for exciting linear and torsional vibrations are described, which are characterized by the magnitude of excitation at any frequency being capable of adjustment during running.

Aero-Elastic Problems

By A. G. Pugsley. Published in *Aircraft Engineering*, October, 1937, p. 268. [A-1]

This paper seeks to draw from current research work on flutter and related problems results of general design significance; and, avoiding mathematics, endeavors to set these results out in relation to past and present problems.

A preliminary section of the paper indicates the main stability and allied troubles concerned and draws attention to the general similarity between wings and tailplanes in relation to these troubles. The remainder of the paper is then devoted to a discussion of the problems involved in terms of wings and ailerons.

Appendices are given commenting on the variation of wing flutter speed with altitude and on the modern tendency to use wings of low flexural stiffness.

CHASSIS PARTS

Automobile Gears

By W. A. Tuplin. Published in *Institution of Automobile Engineers Journal*, October, 1937, p. 11. [C-1]

This paper constitutes a review of modern practice in automobile gear design and manufacture under the headings: types of gears, form of tooth, diameter modification or "correction," advantages of involute system, automobile gear materials, load capacity, permissible stress in gears, reduction ratio, efficiency, temperature rise, noise, gear failures, lubrication, production of gears. Two tables are appended covering

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Ma'erial: H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

basic stresses for materials for automobile gears and approximate wheel diameters in rear-axle drives.

Die Berechnung der Kraftwagenfederung auf Schwingungstechnischer Grundlage

By E. Lehr. Published in *Automobiltechnische Zeitschrift,* Aug. 25, 1937, p. 401. [C-1]

To lay down clear, fundamental rules which will enable the designer to select for any given automobile a suspension system with the optimum springing characteristics is the author's objective. He bases his treatment of suspensions on vibration technique, on the ground that the movements that the car undergoes during operation are vibrations excited by the unevenness of the road. In order that these vibrations may be most favorably dealt with, the vehicle must be endowed with the correct vibration characteristics. His investigation is designed to determine what factors are involved in producing these characteristics, and how these factors must be controlled to ensure the most favorable riding qualities.

The criteria of good riding quality adopted is that the vibration frequency shall lie between 80 and 120 a minute, that all acceleration shall be reduced to a minimum and that vibration shall be damped as soon as possible after each impact. No account is taken of change in suspension characteristics with change of car loading, or of the effects of upholstery.

After describing in some detail experimental methods for determining the vibration characteristics of a car, the author shows how such data should be applied in the design of a suspension system, by laying down 10 rules which should be followed. These rules deal with the position of the rear axle, the characteristics of the springs and damper, and axle weights.

ENGINES

On the Art of Dynamometry with Particular Reference to the Measurement of Engine Power in Flight

By N. S. Muir. Published in *The Journal of the Royal Aeronautical Society,* October, 1937, p. 864. [E-1]

The paper is divided into three parts:

Part I – Historical – a discussion of the development of the art of dynamometry with reference to those machines which represent the milestones that have been erected on a long road of evolution and invention during the past 180 years.

Part II – A brief reference to the problem concerning the variation of engine power with height and some notes on a few attempts at a solution by direct measurement.

Part III – A description of a new transmission dynamometer developed primarily for use in aircraft, together with some of the results already obtained in flight at the Royal Aircraft Establishment.

Recent Developments in Engine Indicators

By E. M. Dodds. Published in *Institution of Automobile Engineers Journal,* November, 1937, p. 41. [E-1]

The author outlines the experimental work which contributed to the development of the cathode-ray indicator which is described in detail. Mr. Dodds points out that among the advantages of such an indicator is its ability to magnify on the time base any desired portion of the engine cycle which may be selected, thus enabling a very close study to be made of such phenomena as ignition lag in compression-ignition engines and detonation in gasoline engines, both of which occur during such a small crank angle that analysis is practically impossible on the conventional pressure-time diagram. In addition to pressure-time oscillograms, it is possible to obtain very simple oscillograms representing: (a) motion of engine parts, e.g., the lift of an injector needle valve emitting fuel to a compression-ignition engine cylinder; and (b) ionization oscillograms representing time of arrival and persistence of flame at any required point in the cylinder-head.

In conclusion Mr. Dodds points out that in spite of the intensive research of the last few years on engine indicators, no method yet tried is completely successful on the modern aircraft engine. However, the author feels that the ultimate solution of the problem is not too far distant, and expresses the belief that change of resistance with pressure appears to be the most likely answer, especially if it can be achieved without the medium of a diaphragm. Manganin is being experimented with in this connection.

The Behavior of Oil Coolers

By M. A. A. Allfrey. Published in *Aircraft Engineering,* October, 1937, p. 257. [E-1]

For a variety of reasons, the problem of cooling the oil in the modern airplane engine has recently become one of importance. In this article the author discusses the theoretical principles on which honeycomb oil cooler design should be based in order to achieve the maximum cooling efficiency combined with minimum drag and minimum danger of freezing up.

Horsepower at Altitude

By G. O. Anderson and M. Thomas. Published in *Aircraft Engineering,* September, 1937, p. 233. [E-1]

The authors point out that there have been many articles published from time to time referring to the Official Air Ministry data for the conversion of observed test bench powers and

boost of supercharged engines to corrected powers and boosts at altitude.

These corrections are essential since it is impracticable to attain complete altitude conditions for production engine testing without resorting to expensive and elaborate plant. The usual method is to run the engine at full throttle with the air supplied to the intake at a pressure corresponding to the International Standard Barometer Pressure at the altitude for which the corrected power and boost is required.

To the observed data obtained in this manner is applied the correction of the compression ratio of the blower at the reduced temperature of the rated altitude. From this correction the true boost at altitude can be determined, and having determined this boost the observed power can be corrected for the increase in inlet charge pressure. This power is further corrected for the difference between the observed air intake temperature and the standard atmospheric temperature at rated altitude. Finally the power at altitude is attained by the application of a correction for the reduced back pressure effect at altitude.

The authors cite references for the complete correction factors and tabulations and explain that the purpose of the present article is to describe a concise but accurate method of determining the corrected power and boost without having to resort to the several long and rather laborious stages in the method cited.

Situation des Constructeurs de Moteurs Français en Matière de Combustibles

By M. G. Mahoux. Published in *La Technique des Industries du Pétrole*, No. 271, p. 96. [E-1]

In time of war, how could France fuel her aircraft with domestic products and still meet the problem of detonation? With high-octane fuels of foreign origin no longer available, and tetraethyl lead, for reasons given, rejected, France would have to rely on fuels with octane numbers as low as 45. Means must be found to raise the anti-knock quality of such fuels.

Tentative suggestions made are the use of ternary blends involving the use of alcohol or benzol, and water injection during the admission or exhaust stroke. Results of preliminary tests are given which seem to indicate promise for these expedients. Two tanks might be used, one for a basic low octane fuel for normal operation, and the other for a detonation suppresser to be added to the fuel when extra power is needed. Cooling the combustion chamber as a method of retarding the evil effects of detonation is another expedient mentioned.

Der Leistungsaufwand beim Anlassen von Verbrennungskraftmaschinen

By Prof. Dr.-Ing. Triebnigg. Published in *Automobiltechnische Zeitschrift*, April 10, 1937, p. 183. [E-1]

Starting torque requirements for a number of Diesel engines of various sizes were determined, using oils of various viscosity characteristics over a wide range of temperatures and with different engine compressions. Practical examples are given, showing how the size of starter required may be calculated from such determinations, taking into account necessary starting speed, compression ratio and bearings.

Possible developments that will reduce the size of the starter required are said to be: lower starting speed, the use of roller instead of plain bearings, and preheating the engine.

MATERIAL

Research in Relation to the Motor Vehicle —Fuels and Lubricants

By F. H. Garner. Published in the *Journal of the Institution of Petroleum Technologists*, October, 1937, p. 575. [G-1]

The author presents a broad summary of the progress in research as affecting fuels and lubricants making reference to fuel research, much of which was carried out some years ago which is equally applicable to fuels of today. No attempt has been made to consider fundamental research on combustion, but the paper is confined to the results obtained by research on problems more directly connected with the practical operation of the engine.

Close collaboration between engine manufacturers and fuel and lubricant producers has inspired this research which has contributed largely to the improved performance of the modern car as regards flexibility and freedom from trouble.

The subject is discussed under the headings: fuels for petrol engines, (a) ease of starting, (b) warming-up and acceleration, (c) vapor lock, (d) dilution, (e) antiknock qualities and road ratings, (f) economy; fuels for compression-ignition engines; lubricants, (a) engine lubricating oils, (b) sludge formation, (c) bearing corrosion, (d) oiliness agents, (e) oil consumption; and extreme pressure lubricants.

The Determination of the Ignitability of Diesel Oils on a Laboratory Scale

By R. Heinze and M. Marder. Published in the *Journal of the Institution of Petroleum Technologists*, October, 1937, p. 603. [G-1]

Although in several recently published articles the reliability of the laboratory methods for determining the ignitability of diesel oils has been repudiated, this report shows that, by the proper application of the parachor or density

method developed by the authors, cetene values well comparable with those determined by engine tests are obtained. Standard as well as substandard testing oils, and also diesel oils of any origin, as for instance from crudes, lignite tar, coal tar or those manufactured by hydrogenation, by synthesis or by extraction, when tested by the parachor and density method, yielded within very narrow limits the same cetene values as determined by engine test with the aid of the C.F.R. Engine.

It is further indicated that well agreeing cetene values can be determined not only by means of the parachor and density methods, but also by the aid of numerous other constants, as for instance the diesel index, the ring-analysis value and also the calorific value, the hydrogen and carbon content, the ratio of carbon-hydrogen and so forth, and cetene values can be obtained by these methods in good agreement with those determined in the testing engine.

Uber die Bestimmung der Zündwilligkeit von Dieselkraftstoffen

By M. Marder and P. Schneider. Published in *Automobiltechnische Zeitschrift*, April 25, 1937, p. 195. [G-1]

Under the auspices of the German transport ministry, the present research on methods of measuring the ignition characteristics of Diesel fuels was carried out in the lignite and petroleum research department of the Berlin engineering college.

The object of the investigation was to determine the correlation between cetene numbers as determined in the CFR engine and as calculated from the density and boiling point of the fuel. Calculated and measured cetene numbers are reported for more than 200 Diesel fuels of various origins and methods of production. Calculated and measured critical compression ratios are also included.

In all cases in which the cetene number could be experimentally determined in the CFR engine, good agreement was found between the engine and physical-chemical calculated values, the maximum deviation being 5 cetene units and the average ± 1.6 units. Increasing deviation with higher cetene numbers is explained as due to the characteristic behavior of the engine in the testing of such fuels. Calculated values, it is pointed out, may also be obtained when engine values cannot, for instance, for fuels of higher ignition values than cetene, or for fuels of too poor ignition characteristics to burn in the engine, for low boiling fuels that vapor lock, or unusually high viscosity fuels.

The critical compression ratio is said to be a more indicative, easily obtainable and accurate measure of ignition characteristics than the cetene number. The lack of agreement of values in fuels in the higher cetene number range may be avoided by the adoption of the critical compression ratio method. In future investigations the practicability of this method will be tested. In the series reported, the values calculated on the basis of fuel density and boiling point agreed more closely with those determined in the engine than did the calculated and measured cetene numbers.

Pflanzenöle als Dieselkrafstoffe

By Kurt Gaupp. Published in *Automobiltechnische Zeitschrift*, April 25, 1937, p. 203. [G-1]

To determine the suitability of vegetable oils for Diesel fuel a comparison was made of the characteristics and behavior of sesame, soya, peanut, palm, and sunflower seed oil and gas oil. The points investigated were power, consumption, carbonization, oil contamination and engine corrosion. For the first four items tests with a two cylinder, four stroke cycle, precombustion chamber Mercedes-Benz engine were used; for corrosion, a five months' laboratory test.

Provided suitable precautions are taken, vegetable oils are thought, from the results of the investigation, to be thoroughly satisfactory as Diesel fuel. The power produced is about the same as gas oil, with a 12 per cent higher consumption. Vegetable oils affect the lubricant differently from the usual Diesel fuels; this difference does not react harmfully in the operation of the engine, but should be taken into account in the choice of lubricating oils. The strong corrosive action of vegetable oils can be counteracted by the choice of suitable engine materials. The fuel should be preheated and should be thoroughly filtered. A mineral fuel should be used for starting, and the combustion chamber and fuel nozzles checked more frequently for carbonization than is necessary with mineral oils.

Untersuchung Geschweisster Aluminiumbleche Grösserer Dicke

By H. Buchholz. Published in *Zeitschrift des Vereines Deutscher Ingenieure*, April 10, 1937, p. 433. [G-1]

The object of these tests was to determine the strength characteristics of welds in heavy aluminum sheets, when different welding methods and materials were used. The sheets used were 25 mm. (about 1 in.) thick, of annealed aluminum, 99.5 per cent commercially pure. Welding rods of pure aluminum, and of aluminum with 5 per cent silicon and with 2 per cent titanium were used. The electrodes were of pure aluminum. Two methods, acetylene welding with X seams, and electric arc welding with V seams, were employed.

The structure of the welds and adjoining metal was examined by means of X-ray. Tension, bending, hardness and corrosion-resistance tests were also made.

A finer structure was produced by the gas welding and X seams than by the electric arc welding and V seams. The static strength of the welds made by different methods and with different materials was the same or nearly the same as that of the annealed unwelded metal. Within the range affected by the high welding temperature, a not inconsiderable lowering of the yield point was found. Provided that the workmen are skillful, electric arc welding was thought to be as capable of producing reliable welds of the same strength and corrosion resistance as result from gas welding. The gas welds studied in this investigation were freer from slag inclusions than were the electric welds. Both types of weld made with pure aluminum were found to have about the same corrosion resistance as the unwelded metal. Welds made with aluminum-silicon alloy were found to have no more favorable strength characteristics than those made with the pure aluminum, while their lower corrosion resistance made them unsuitable. Titanium alloys produced stronger but somewhat less corrosion-resistant welds.

MOTOR-TRUCK

Pendelbewegungen von Lastkraftwagen-Anhangern und Ihre Vermeidung

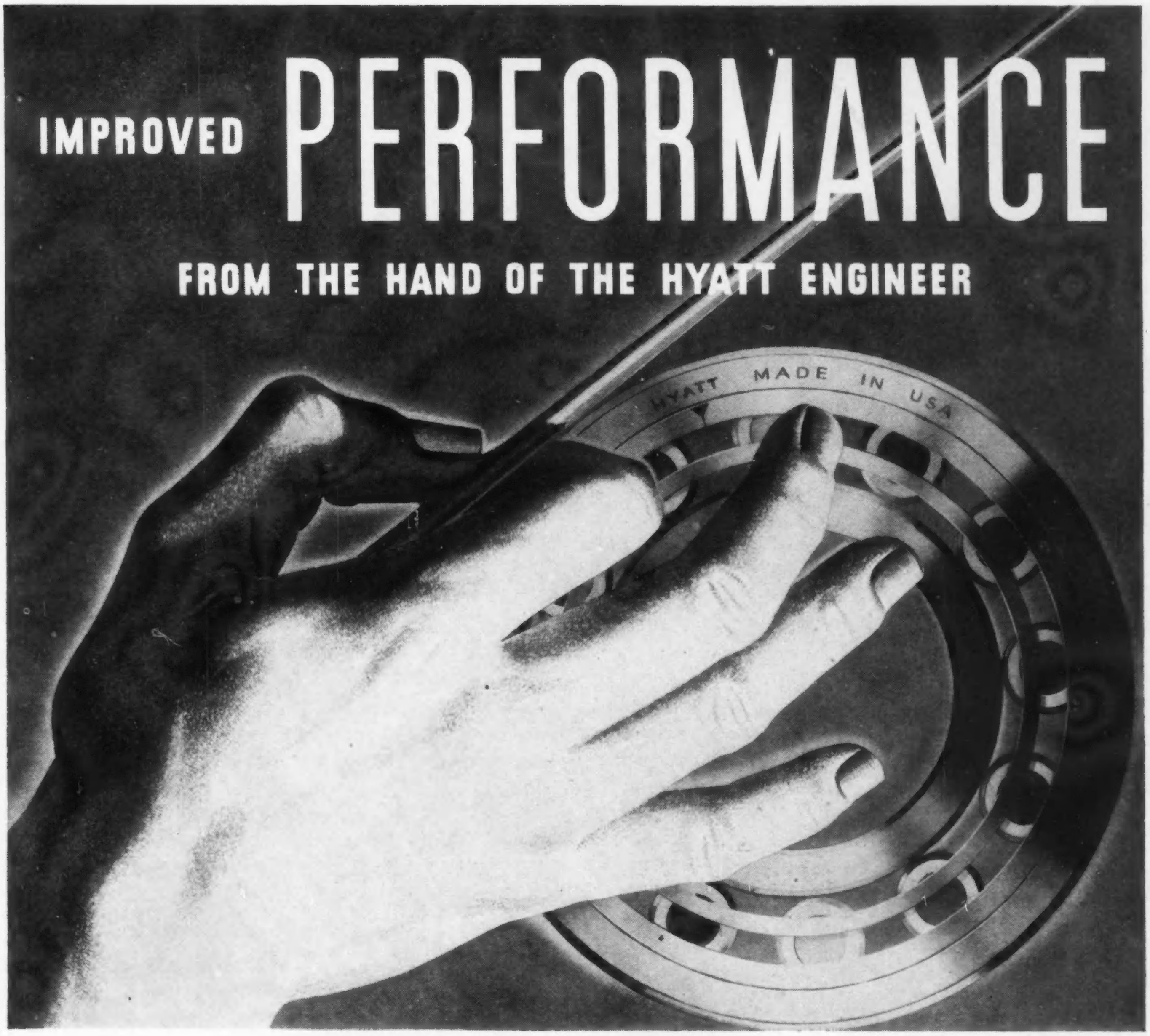
By L. Huber and O. Dietz. Published in *Zeitschrift des Vereines Deutscher Ingenieure*, April 17, 1937, p. 459. [K-1]

At the request of the Association of German Trailer Manufacturers, the automotive and automotive engine research institute of the Stuttgart engineering college carried out this investigation on the nature, causes and cure of motor-truck trailer sidesway.

The investigation was carried out for the most part by means of models, about 1/10 the size of actual vehicles. The model vehicles stood still, while the model street beneath them moved at speeds representing actual speeds up to 95 m.p.h. The wheelbase length of hole, load distribution, type of axle and coupling, fifth wheel or steering knuckle, could be altered at will in the model. Photographic records were made of the model trailer movements. Sufficient road tests were made with full-size vehicles to check the applicability of the model tests to actual conditions.

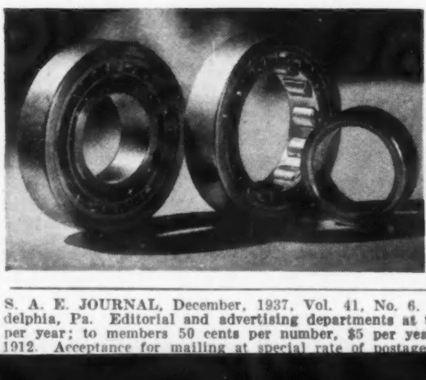
Factors found to increase sidesway were: play in the coupling, tires with weak side walls; short wheelbase; short pole; low tension on the pole; coasting of the trailer; extensive pintle hook movement; and friction in the fifth wheel or steering knuckle coupling. Axle load distribution had only a slight effect. Design features that were found to decrease sidesway were: long wheelbase; long pole; pintle hooks restricted as to sidewise movement; front wheel trailer braking; and damping of the movement of the pole about the pintle hook at the same time increasing the rigidity of the coupling against buckling during coasting of the trailer.


built
to be
forgotten



HYATT

ROLLER BEARINGS



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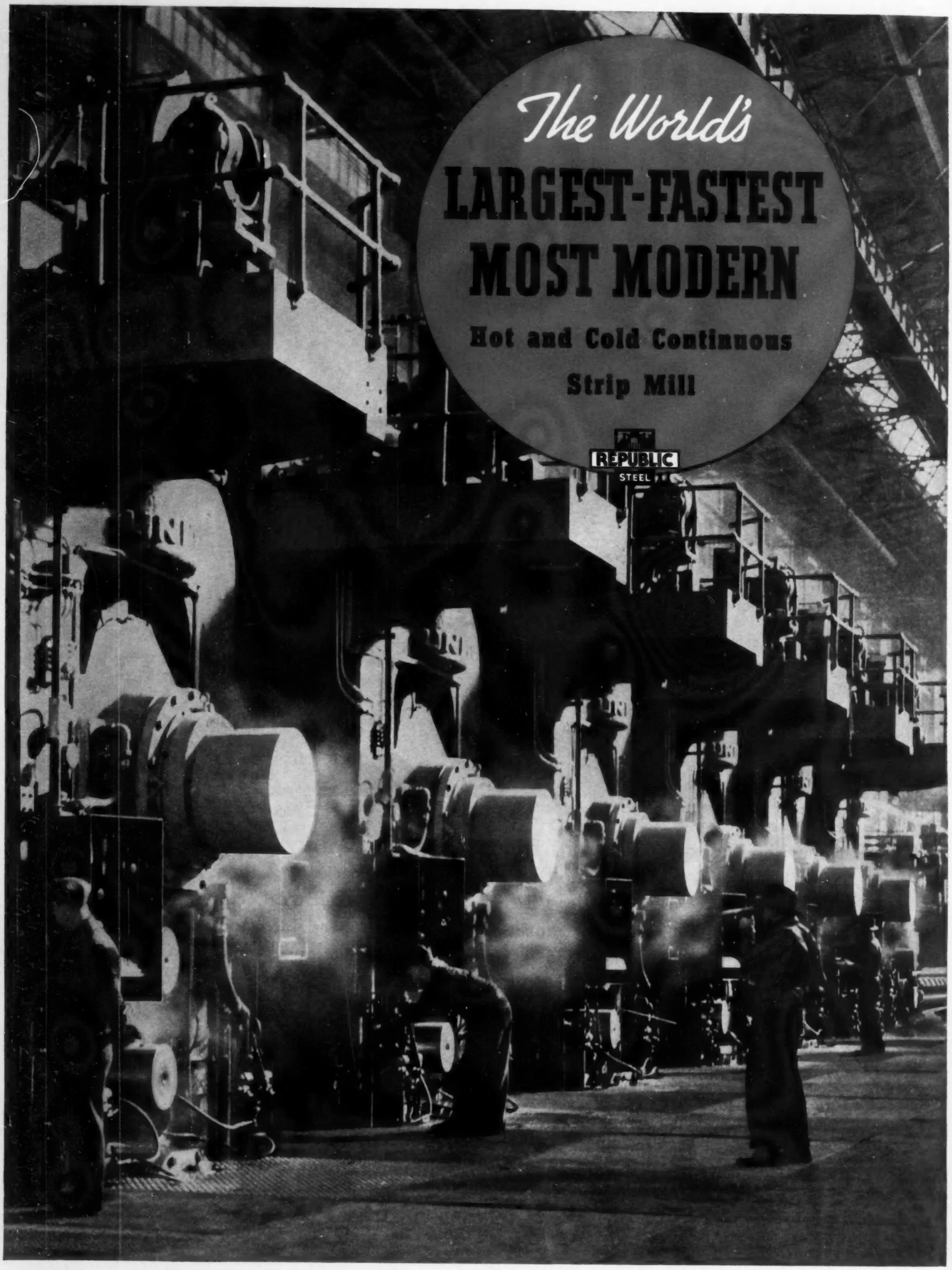
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Hot and Cold Continuous
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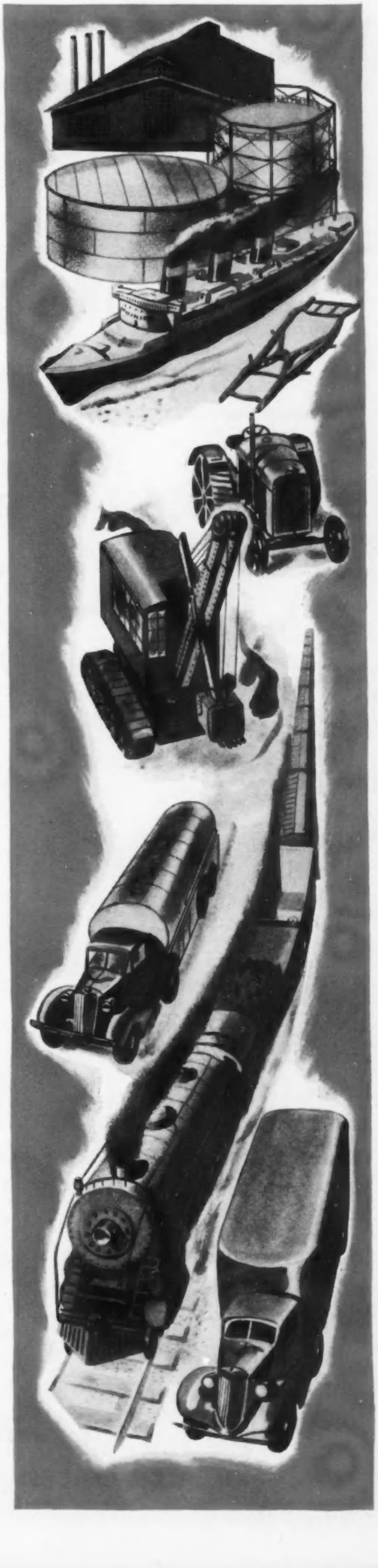


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Firestone Type RI rims are for cast wheels; Type RH for disc wheels. The same side ring fits both.
Only Firestone makes a complete line of continuous construction rims in all types and sizes for every type of vehicle. For greatest service and satisfaction always specify Firestone Rims.
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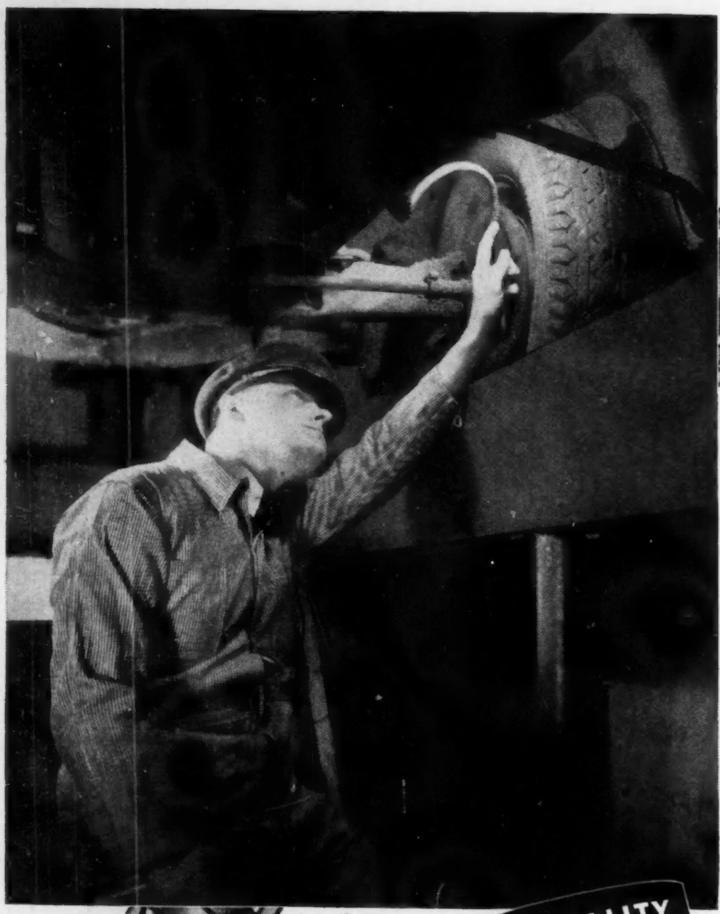
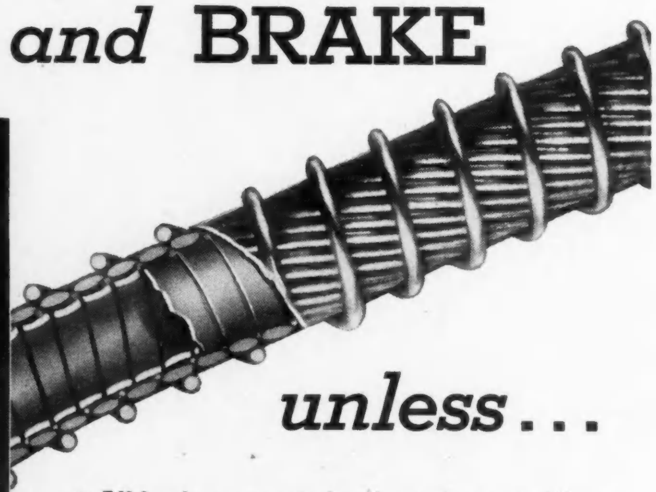
Here's the DANGER POINT *between* DRIVER *and* BRAKE





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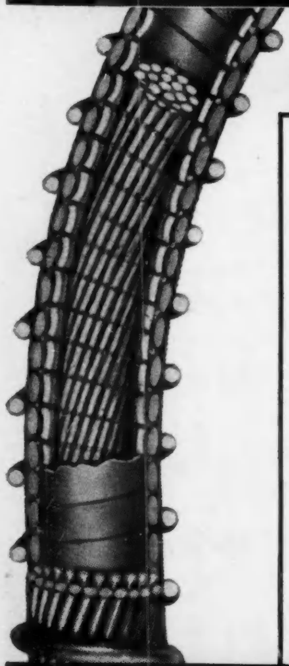

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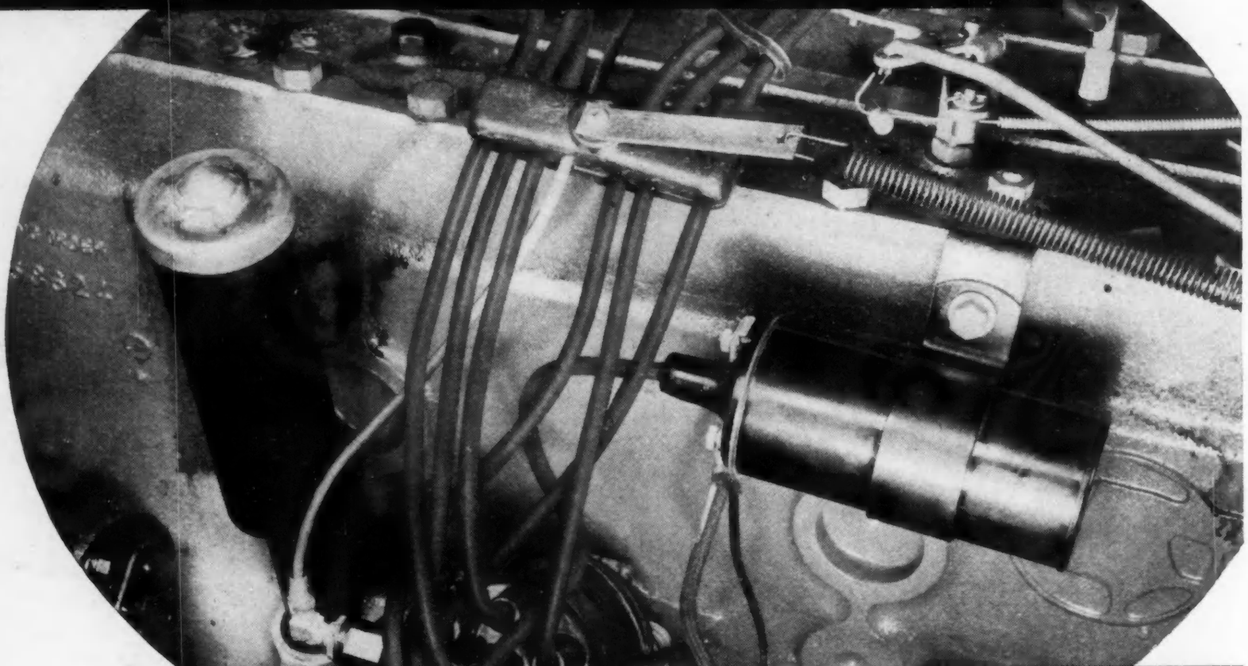

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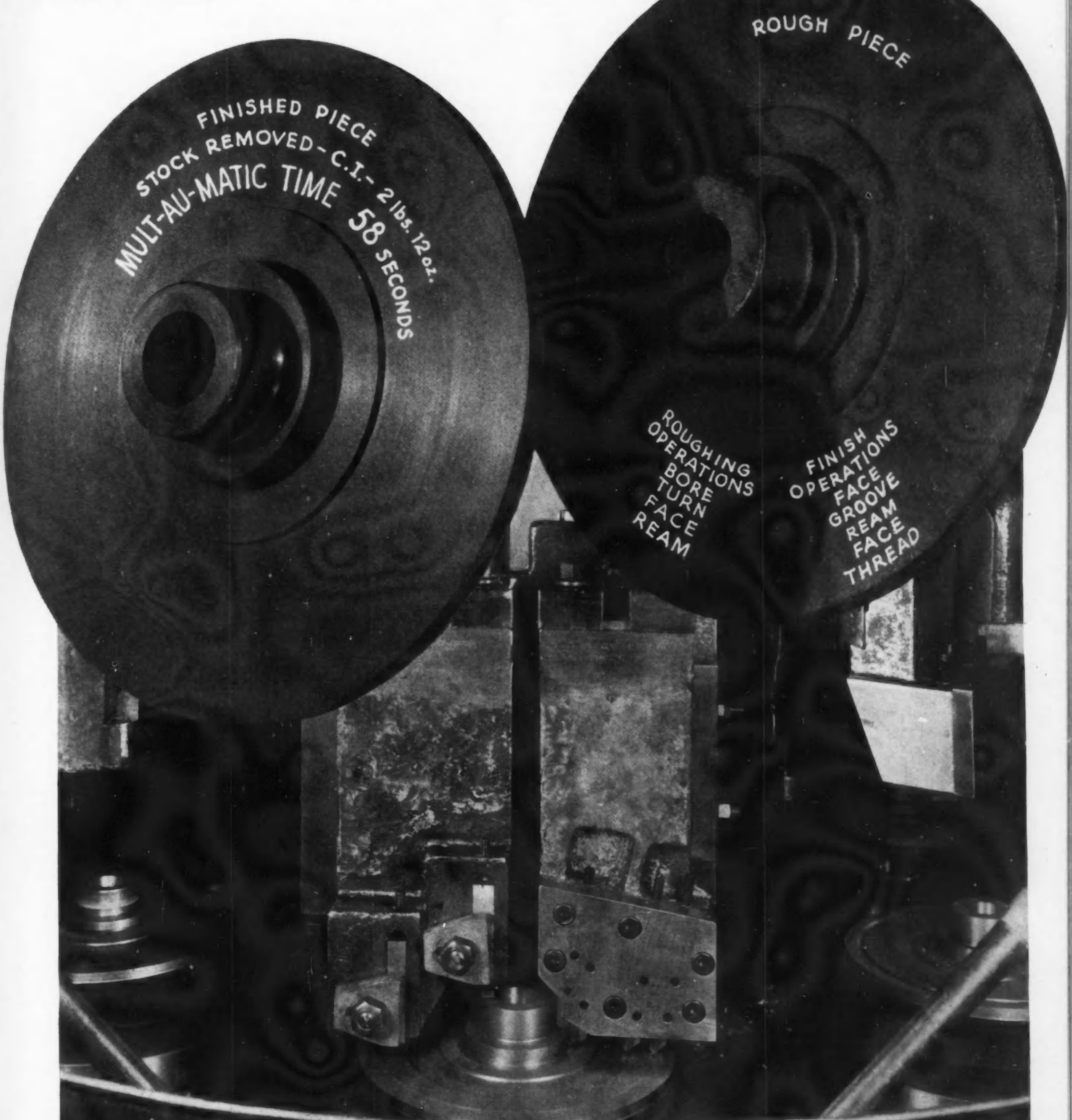

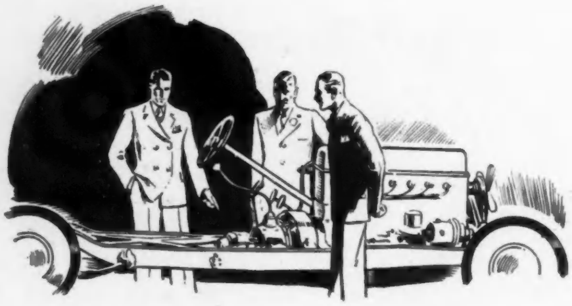

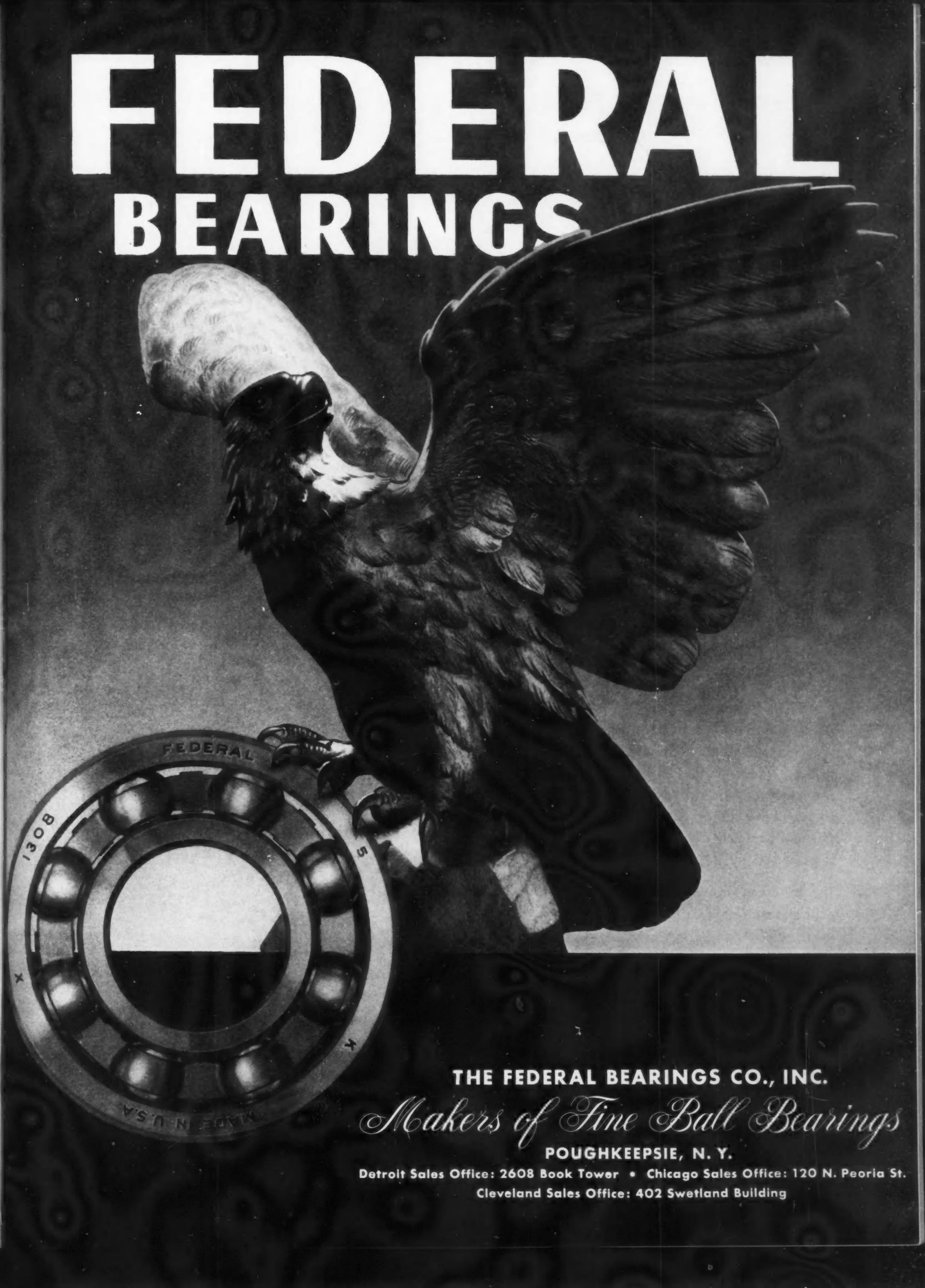
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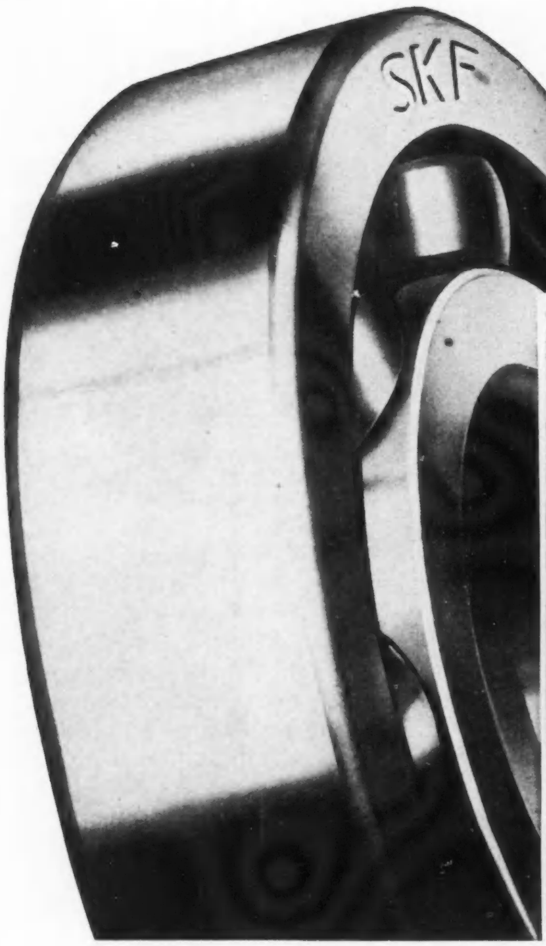

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Houde Engineering Corp.
Silencers, Carburetor Intake
AC Spark Plug Division
Sound Deadening Materials
Detroit Gasket & Mfg. Co.
Spark Plugs
AC Spark Plug Division
United American Bosch Corp.
Spectrophotometers
General Electric Co.
Speedometers
AC Spark Plug Division
Springs, Coiled
Barnes-Gibson-Raymond, Division of Associated Spring Corp.
Cook Spring Co. Division
Springs, Flat
Barnes-Gibson-Raymond, Division of Associated Spring Corp.
Cook Spring Co. Division
Stampings
Cook Spring Co. Division
Spicer Mfg. Corp.
Starting-Motor (Standard Mountings)
Electric Auto-Lite Co.
Starting Motors
United American Bosch Corp.
Steel Alloy
Bethlehem Steel Co.
Timken Roller Bearing Co.
Timken Steel & Tube Co.
Steels, Automotive
Ingersoll Steel & Disc Division
Steel, Carbon
Timken Roller Bearing Co.
Steel, Die Rolled
Republic Steel Corp.
Steel, Electric Furnace
Timken Roller Bearing Co.
Timken Steel & Tube Co.
Steel, Non-Corrosive
Bethlehem Steel Co.
Steel, Open Hearth
Carnegie Steel Co.
Timken Roller Bearing Co.
Timken Steel & Tube Co.
Steels, Plow
Ingersoll Steel & Disc Division
Steels, Saw
Ingersoll Steel & Disc Division
Steel, Special Analysis
Carnegie-Illinois Steel Corp.
Columbia Steel Co.
Timken Roller Bearing Co.
Timken Steel & Tube Co.
United States Steel Corp.
Steel, Stainless
Republic Steel Corp.
Steel, Tool
Timken Roller Bearing Co.
Timken Steel & Tube Co.
Steel Tubes
Steel & Tubes, Inc.
Strainers, Gasoline
AC Spark Plug Division
Strip, Cold Rolled Steel
Republic Steel Corp.
Strip, Hot Rolled Steel
Republic Steel Corp.
Switches
United American Bosch Corp.
Switches, Starting
Electric Auto-Lite Co.
Tappets
Wilcox-Rich Corp.
Testers, Headlamp
Thompson-Bremer & Co.
Thermostats
Dole Valve Co.
Timer-Distributors
Electric Auto-Lite Co.
Tires, Pneumatic
Goodyear Tire & Rubber Co., Inc.
Tires, Servicing Equipment
Dill Mfg. Co.
Tires, Solid
Goodyear Tire & Rubber Co., Inc.

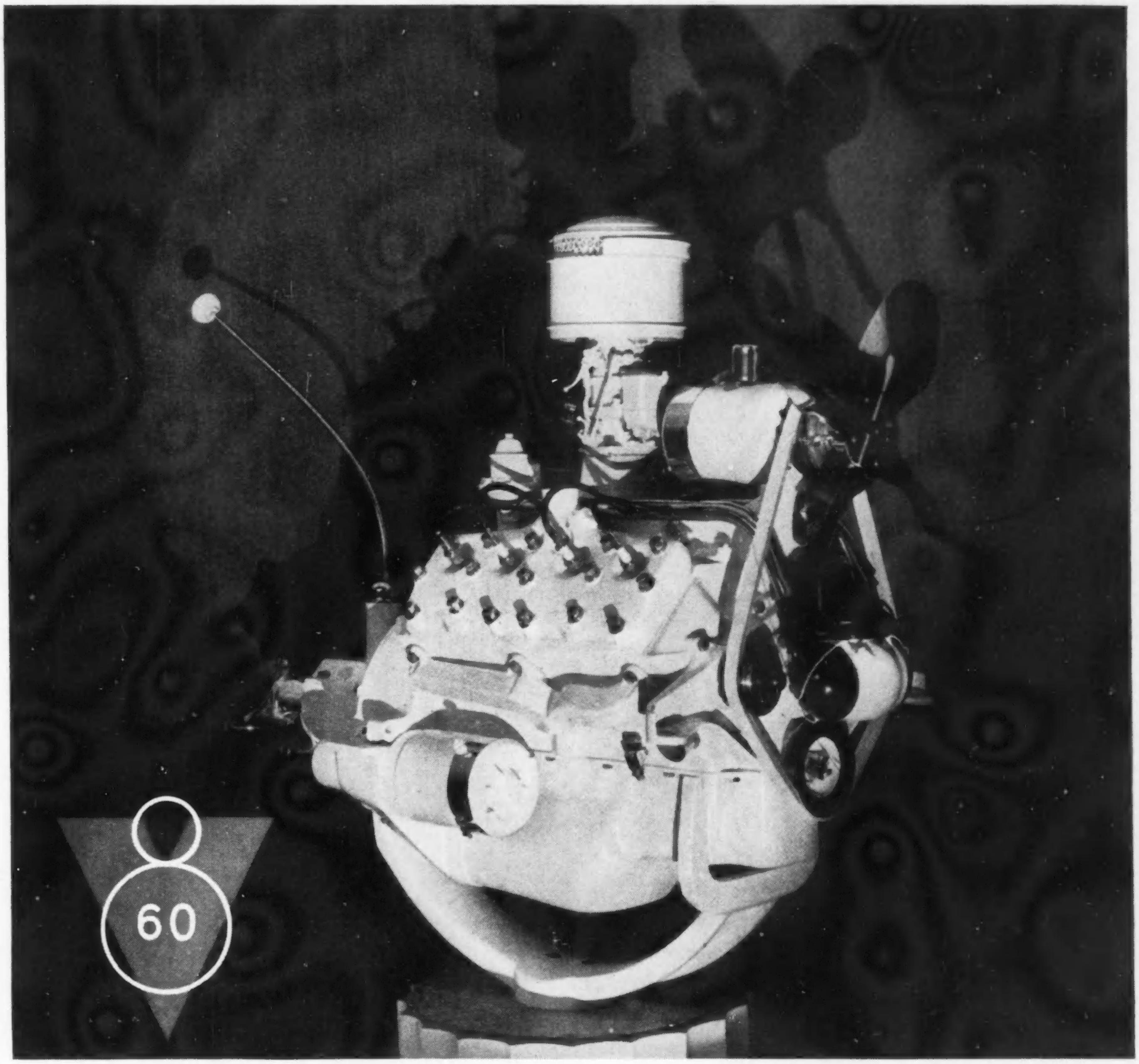
Tools, Small Cutting and Grinding
White Dental Mfg. Co., S. S.
Transmissions
Brown-Lipe Gear Corp.
Trucks, Motor
Ford Motor Co.
Tubes, Steel
Steel & Tubes, Inc.
Tubes, Steel, High Pressure
Steel & Tubes, Inc.
Tubes, Structural Steel
Steel & Tubes, Inc.
Tubes, Tire, Servicing Equipment
Dill Mfg. Co.
Tubing, Brass
Bundy Tubing Co.
Tubing, Copper
Bundy Tubing Co.
Tubing, Flexible Composition
Flex-O-Tube Co.
Tubing, Flexible Metal
Titeflex Metal Hose Co.
Tubing, Flexible, Non-Metallic
Weatherhead Co.
Tubing, Steel
Bundy Tubing Co.
Tubing, Steel, Seamless
Timken Roller Bearing Co.
Timken Steel & Tube Co.
Tubing, Welded and Sweated Steel
Bundy Tubing Co.
Tungsten, Metallic
Vanadium Corp. of America
Valves, Hydraulic
Houde Engineering Corp.

Valves, Intake and Exhaust
Thompson Products, Inc.
Valves, Poppet
Wilcox-Rich Corp.
Valves, Tire
Dill Mfg. Co.
Schrader's Son, A.
Vanadium Pentoxide
Vanadium Corp. of America
Washers, Bronze
Bunting Brass & Bronze Co.
Washers, Lock
American Nut & Bolt Fastener Co.
Beall Tool Co.
Butcher & Hart Mfg. Co.
Eaton Mfg. Co.
Hobbs Mfg. Co.
National Lock Washer Co.
Philadelphia Steel & Wire Corp.
Positive Lock Washer Co.
Shakeproof Lock Washer Co.
Thompson-Bremer & Co.
Washburn Co.
Washers, Spring
American Nut & Bolt Fastener Co.
Beall Tool Co.
Butcher & Hart Mfg. Co.
Eaton Mfg. Co.
Hobbs Mfg. Co.
National Lock Washer Co.
Philadelphia Steel & Wire Corp.
Positive Lock Washer Co.
Shakeproof Lock Washer Co.
Washburn Co.
Windshield Wipers
United American Bosch Corp.
Zinc, Alloys
New Jersey Zinc Co.
Zinc, Sheet
New Jersey Zinc Co.
Zinc, Slab
New Jersey Zinc Co.
Zinc, Stick
New Jersey Zinc Co.

The addresses of companies listed in this index can be obtained from their current advertisements indexed on page 62

INDEX TO ADVERTISERS

The Index to Advertisers' Products is given on pages 58 and 60



PUBLIC ECONOMY No. I

V-type eight-cylinder engines were put in Ford cars over a chorus of "can'ts" and "never will bes." For years eight-cylinder cars were mentioned in the same breath with mink coats and big bank balances.

It took the unequaled experience and tremendous manufacturing facilities of the Ford Motor Company to bring the V-8 engine to the low-price field.

For years it was said that eight-cylinder engines cost more to run. Henry Ford believed that design—and not the number of cylinders—determined the cost of running an engine. Laboratory and road tests proved to his satisfaction that he was right. Ford facilities and experience kept production costs down—and the Ford V-8 was introduced to the world.

The records of oil and gasoline economy turned in from then on by Ford owners over millions of road miles proved conclusively that added cylinders had little to do with operating costs. Thus, the Ford V-8 engine proved its ability to meet the rigid economy requirements of the low-price field.

If any lingering doubt existed, the Ford V-8 "60," introduced a year ago, swept it aside and proved beyond question that V-8 engines can be built to operate with rock-bottom economy.

Instinctively the world of thrifty motorists responded to the announcement of a smaller Ford V-8 engine—and it was right! Letters began to pour in with records of 22 to 27 miles to the gallon—and even more!

In the first year of its career more than 300,000 motorists adopted the 60-horsepower Ford V-8. It became, in short, Public Economy No. 1. Today, it is the symbol of economy in fine-car motordom. That is appropriate, since "economy" is—and always has been—a Ford word.

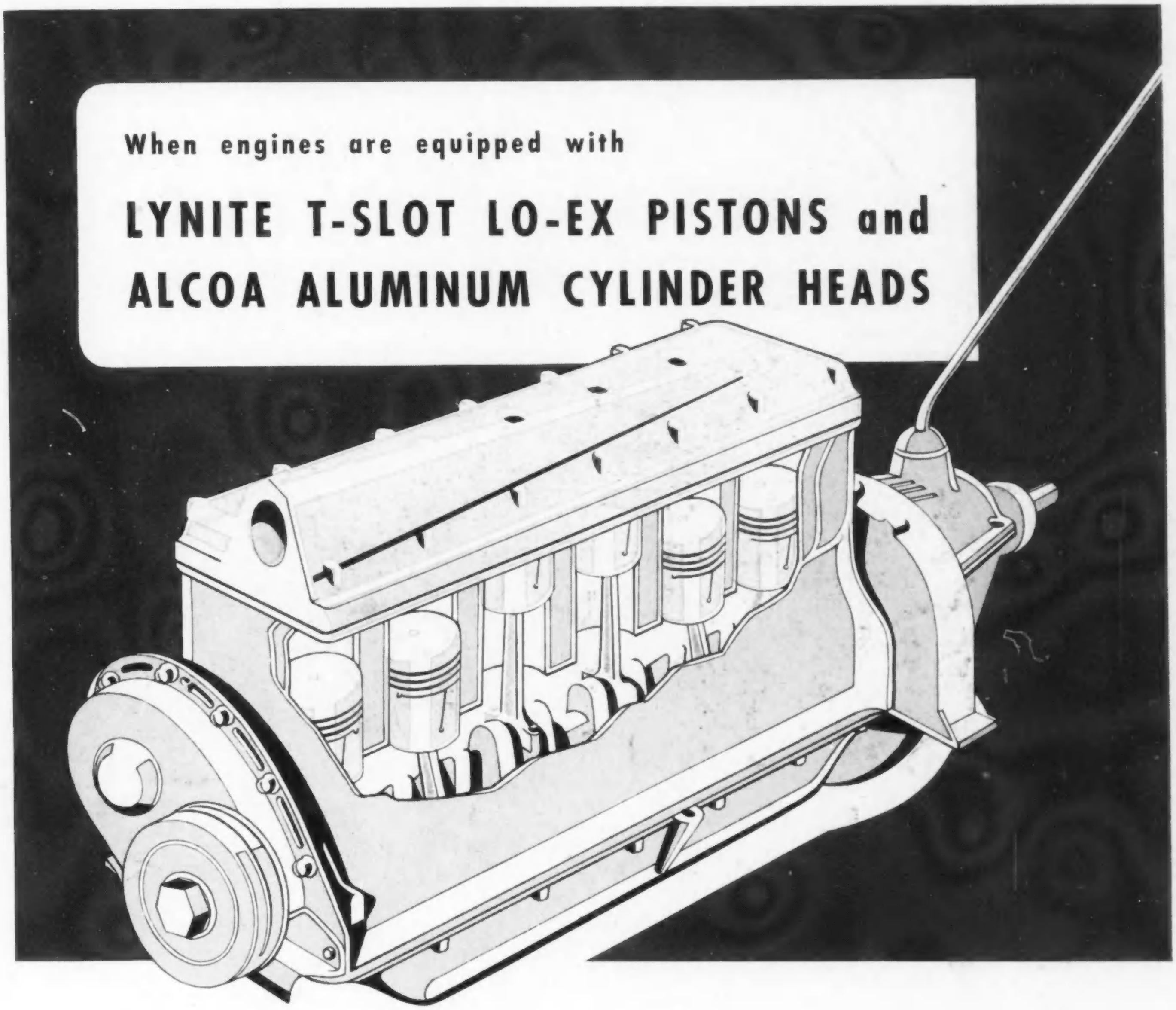
Ford

FORD MOTOR COMPANY

S·A·E Journal

DECEMBER 1937

THE SOCIETY OF AUTOMOTIVE ENGINEERS



The car buyer gets greater value; more power, better fuel economy, longer engine life. The wise salesman makes capital of these advantages in the car he is demonstrating.

Lynite T-Slot Pistons of LO-EX Alloy are light in weight, thereby reducing bearing pressures and contributing to longer bearing life. They have low coefficient of expansion; they permit close clearance; they give maximum heat flow, stand up under high compression, and insure minimum oil consumption and less carbon.

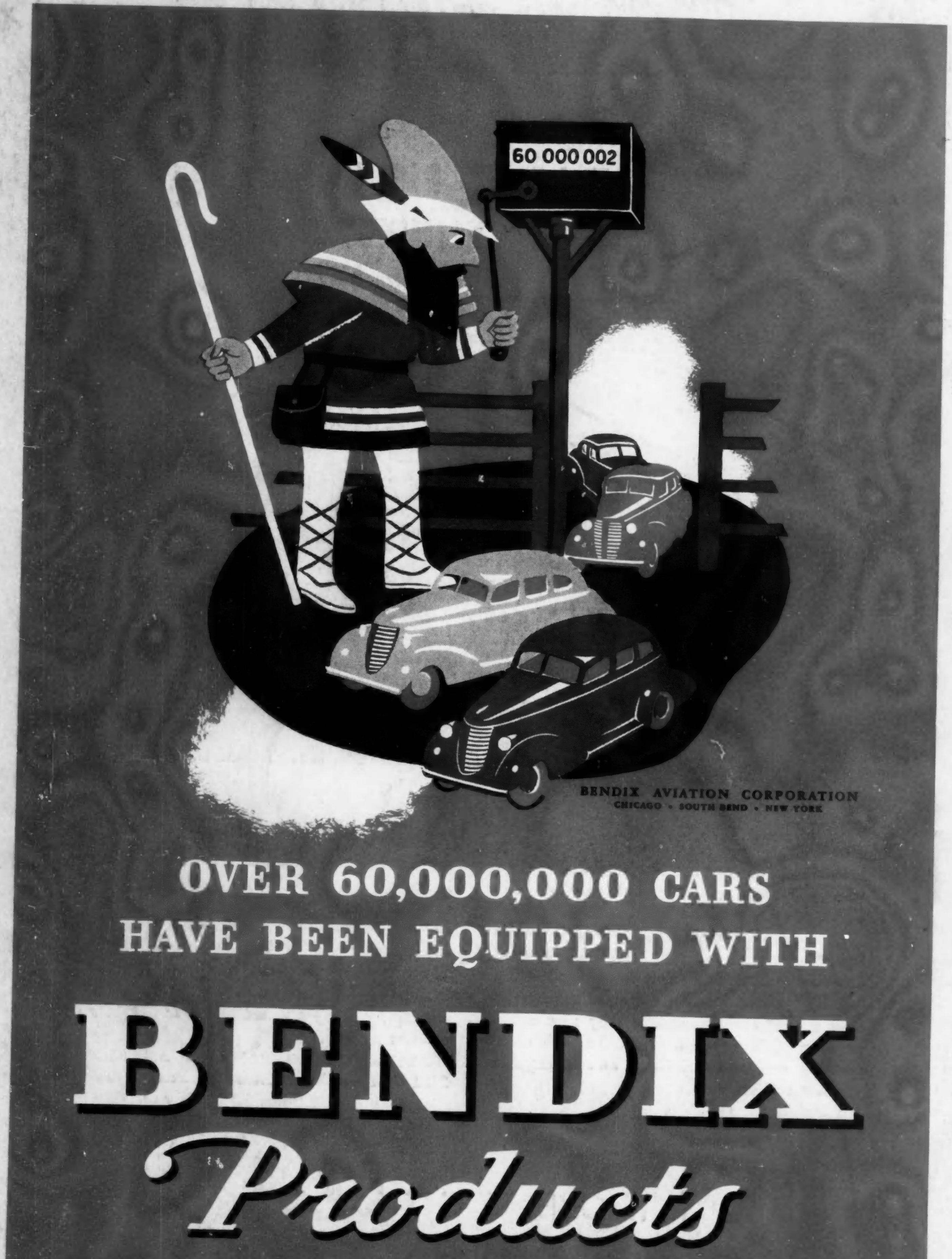
Aluminum cylinder heads distribute heat more uniformly — eliminate hot spots. Power is increased 5% to 15% with low operating costs. Alcoa cylinder head castings have these advantages; superior hardness and toughness of threads are secured by coring and chilling of spark plug holes; finer appearance, greater accuracy, and soundness are achieved in the casting by using a metal mold for the entire exterior surface.

ALUMINUM COMPANY OF AMERICA,
2181 Gulf Building, Pittsburgh, Pennsylvania.

LYNITE ALCOA

PRODUCTS OF

ALCOA · ALUMINUM


60 000 002
BENDIX AVIATION CORPORATION
CHICAGO • SOUTH BEND • NEW YORK
OVER 60,000,000 CARS
HAVE BEEN EQUIPPED WITH
BENDIX
Products